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USSR Report

SCIENCE AND TECHNOLOGY POLICY

SPECIAL NOTICE INSIDE

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JPRS-UST-87-008
28 MAY 1987

USSR REPORT

Science and Technology Policy

Contents

ORGANIZATION, PLANNING AND COORDINATION

RESPONSES TO PRAVDA QUESTIONNAIRE ON REORGANIZATION OF WORK

Moscow PRAVDA in Russian 5 Aug 86 p 2

[Article by V. Kozhemyako: "How Is the Reorganization Going? The Responses to the PRAVDA Questionnaire Talk About This"; first six paragraphs are PRAVDA introduction]

[Text] The 27th CPSU Congress called the reorganization of party and economic work a matter of vital importance. How is it to be carried out more successfully? The questionnaire of PRAVDA, which the editorial board addressed to workers and kolkhoz farmers, scientists and specialists, executives of ministries and departments, and party and economic workers, was devoted to this theme. Let us recall the questions of the questionnaire:

1. How is the reorganization going in your collective and party organization?

2. What experience of work in the new way merits attention and dissemination?

3. What, in your opinion, is hindering the reorganization?

The editorial board received many replies. A portion of them have been printed in the newspaper. While today we are publishing a survey of the readers' responses. We begin with the responses to the first two questions. There is at present no more urgent and vitally important a task than the gathering by bits of the experience, to which life gives rise, the experience, which is aimed at the solution of the problems of accelerating the socioeconomic development of the country. The urgency of this was spoken about at the June CPSU Central Committee Plenum and in the speech of M.S. Gorbachev in Khabarovsk.

Thus, what from their own experience of reorganization do the authors of the responses, which were sent to PRAVDA, regard as the most valuable?

The Very Link

When reading the letters you repeatedly recall Lenin's thought about the need at each stage to find the main link, after the grasping of which it is possible to pull out the entire chain. Indeed, life poses for collectives and party organizations an enormous diversity of questions. And in order not to

lose one's head, having encountered them, the most important thing of all, perhaps, is precisely this--to be able to focus on the main thing.

But what is it, the main thing? Let us listen if only to Leonid Vasilyevich Chernyayev, a steel worker of the Cherepovets Metallurgical Combine. First of all he names the Intensification-90 Comprehensive Program, which was formulated at the combine by collective efforts. Why? Because it as if concentrates the efforts of each and everyone in a common main direction.

The program is intense. Here are just a few figures. By means of resource-saving technologies it has been decided to obtain on the operating capacities 85 percent of the increase of output. The technical updating of the combine will make it possible as against the average sectorial level to increase by twofold the growth of labor productivity and to free not less than 1,700 people. The policy of producing advanced types of rolled stock of high-alloy brands of steel will provide a saving of nearly 1.5 tons of metal....

Did they previously really not engage in intensification at the combine? They did, of course. Only all this was disconnected: it turned out that they were using spread fingers. Now they, if it can be expressed this way, are tightly squeezed, by which the energy of acceleration has been increased significantly.

It is not only that the program clearly specified who is to do the work and what amount in the name of the common goal. The regular, close, and most specific monitoring of the fulfillment of what has been outlined is of great importance. Now many people have become good at compiling various kinds of plans and programs. And not everywhere do they know how to transfer these programs persistently and consistently from paper to real life. Here they know how to.

Recently, for example, the party committee heard the report of A. Doronin, chief of one of the machinery and repair shops. He is an authoritative person at the combine, but in recent times has decreased the demandingness on himself. Now he heard criticism directed to himself, which forced him to ponder in earnest and in many respects to change his attitude toward the work. Let us note: here this much is expected not only of managers. It is expected of every worker. Everyone answers to comrades for their personal contribution to the intensification of production. The task is clear: that each person would realize that the success of an important job also depends on him, and not only on someone "from above."

But the first success already exists. For example, in the oxygen converter shop they used a number of innovations, which decreased by 18 kilograms the consumption of pig iron per ton of steel. This alone helped to save about 70,000 tons of metal. The converter operators increased by one-fourth the overhaul life of furnaces, which made it possible to provide 150 additional melts. The assimilation of the new Severnyanka blast furnace, which will soon reach the rated capacity, is proceeding ahead of schedule. The collective of Severnaya Magnitka during the first half of the year sent to enterprises of the country over and above the intense plan 10 trains of metal, coke, and agglomerate. This is what it means to grasp the main link!

Firmly Establishing What Is New

Let us begin here with questions. Do you know, for example, what the combination of letters TMO means? Are you hearing it for the first time? Well, what does MNTK mean? You also do not know?

However, you need not be embarrassed. These names are new, they recently came into general use, moreover, for the present far from everywhere. TMO is territorial intersectorial associations, the first of which appeared in the Georgian city of Poti. MNTK is interbranch scientific technical complexes, which include research, design, technological, experimental, and production organizations. B. Gulua, first secretary of the city party committee, wrote to us from Poti in response to the questions of the questionnaire. Candidate of Chemical Sciences Ye. Malakhov, secretary of the party buro of the Institute of Catalysis of the Siberian Department of the USSR Academy of Sciences, wrote about complexes.

What is new secures itself by specific results. What was begun in Poti as an experiment is now felt here as a necessity. The establishment of the territorial intersectorial association significantly increased the possibilities of the intersectorial coordination of work. For example, the assets for the construction of a machine tool attachments plant were cooperated. Steps are being implemented on the centralized production of other products for intersectorial use--for example, parts made from castings. Cooperation in the use of local raw materials and waste products is being expanded. And how much the settlement of questions of transportation service and power and water supply has been improved!

Figures campaign best of all for an innovation. Here are several of them, which testify to the significant acceleration of the pace of the economic and social development of the city. The plan of the past 5-year period on the output of industrial products was fulfilled half a year ahead of time, the growth rate at the end of the five-year plan came to 42 percent with a plan of 9 percent. Labor productivity was increased by 1.4-fold, by means of which nearly the entire increase of industrial production was derived, while the deductions for the state budget increased by twofold. The new five-year plan was begun punctually.

It remains to be added that territorial intersectorial associations are now also operating successfully in a number of other cities of Georgia. In the letter from Poti the question is posed: "Would our experience interest other republics?"

While the letter with the Novosibirsk postmark tells about the formation of one of the first 16 interbranch scientific technical complexes in the country. It is called the Catalyst Interbranch Scientific Technical Complex. It unites 13 institutes, design bureaus, and plants. The goal is to speed up the journey from the scientific idea to its extensive introduction. The Institute of Catalysis has been entrusted to head the complex.

Scientists of the institute, of course, were also previously concerned about the practical use of their works and about the increase of their national economic impact. "But today we have to take a new significant step toward plant shops and the practical needs of production," V. Malakhov writes. "We regard as our main party assignment the establishment of a well-adjusted interbranch scientific technical complex. This work, which at first glance is scientific organizational work, requires tireless party support. To reject the well-traveled paths, to creatively seek new ways, and not to be afraid to take risks--only in this way will we be able to achieve genuine success in the commenced great experiment. But we began it with the establishment of relations with the party organizations of all the partners. We believe that close contacts along party lines will significantly influence the formation of business relations among the members of the complex and will help to avoid sujectivistic approaches and possible personality conflicts. Our aim: everything in the name of the new promising cause!"

Closer to People

To be closer to labor collectives and primary party organizations, to develop in every possible way their initiative and activity, to support valuable undertakings--this is heard in many responses of the workers of party committees to the questionnaire of PRAVDA. They see the most important components of reorganization precisely in this.

V. Solovyev, first secretary of the Chelyabinsk City Committee of the CPSU, tells what the shift of the center of party work to labor collectives yields. Here much has been done, for example, for the identification of internal reserves at each enterprise. The result? The growth rate, which was established in the ministries for the current year, was increased from 2.7 to 3.1 percent by the counter socialist obligations. While in fact during the first 6 months the increase came to 5.5 percent. Three-fourths of the industrial collectives of the city are exceeding the planned rate.

Particular attention is given to the lagging enterprises. The executives of the city party organization first of all came to the people and to the communists, who work in these collectives, and together with them attempted to identify the causes, which are hindering the work, and the methods of their elimination. As a result they have already gotten out from among the enterprises, which chronically do not fulfill the plan, such enterprises as the plant of heat insulation items, the machinery plant, the electrical repair plant, the plant of machine tool attachments, the knitwear factory, and several others.

Among the party workers of Chelyabinsk the holding of days of the rayon party committees in labor collectives has become a system. The secretaries and chiefs of departments meet with workers, answer their questions, and take an interest in their opinion on some directions or others of their work. And they dispose the economic managers in the city so that they would act not according to the principle "The Plan at Any Price," but would show more concern about people.

Here is a recent fact. The buro of the city party committee held strictly accountable the director and secretary of the party buro of the automotive plant. For what? It would seem that the enterprise fulfills the plan and has frequently won top places in the competition. But when the workers of the city committee spoke with the workers, it became clear: at the plant food service is poorly organized, the personal facilities are in a state of neglect, and other social problems have not been solved for years. Urgent and radical steps had to be taken.

From the letters it is evident that the workers of the party committees are trying today to be more often at the sites, among people. For example, K. Bodyu, secretary of the party organization of the Zarya Kolkhoz of Kriulyanskiy Rayon of Moldavia, writes that after the 27th party congress their farm was visited by the secretary of the republic CP Central Committee (at the meeting of the shop party organization), two chiefs of departments of the Central Committee, and many workers of the rayon committee. How was it in the past? The high-level guest "picked up" the chairman of the kolkhoz in his car and visited a number of parcels with him. On the road he issued instructions, mainly of an economic sense. The visitor often even did not look in on the party committee. Now the nature of such visits is changing.

The admission of V. Slipchenko, first secretary of the Oktyabrskiy Rayon Party Committee of Kharkov, is interesting in this respect. "The other day," he writes, "I decided to visit one of our largest enterprises--the plant of materials-handling equipment. I went into the shops without other workers of the rayon committee and plant managers. And you know, this even surprised some people. They say, how come he is 'without a retinue'? But the workers, on the contrary, turned out to be very satisfied. Because the conditions for a frank discussion existed. The people voiced their opinion about the most urgent thing, to the point, without keeping anything back. Now, I thought, we also need to strive for this. For a confidential heart-to-heart talk."

In the letter of V. Slipchenko there are also thoughts of the following kind: How is one to get through to each communist and to each primary party organization? In the rayon there are 152 of them. Of course, the party committees of large enterprises were not ignored. But who looked in at the party organization of some semiprimitive workers' cooperative for the repair of hardware, where there are only five or six communists?

"There is no time," many party workers say in response to similar questions. "There is not enough time." Let us admit: they have much to do and many concerns. But is it impossible to free time at the expense of numerous meetings and the writing of documents?

Here are several figures from the letter of A. Ilin, first secretary of the Neftegorskiy Rayon Committee of the CPSU of Kuybyshev Oblast. Last year in 6 months 580 documents were sent out from the rayon committee to the primary party organizations, this year 285 were sent out in the same time. During the concluding year of the five-year plan the rayon committee adopted 67 fewer decrees than during the 1st year. It can be said that it is a gratifying statistic. Owing precisely to the significant decrease of paper work the

workers of the rayon committee are spending more than half their time now in the primary party organizations.

And there is another issue which is raised in the responses to the questionnaire: to consider more carefully the opinions of communists and labor collectives when solving any problems. Thus, V. Chetvergov, secretary of the Narva City Party Committee, reports that in the past year more than 500 appointments to management positions were made here after the preliminary discussion of these candidates in the collectives of enterprises and organizations. The city committee intends to expand this practice.

Today, using the responses to the questionnaire of PRAVDA, we have told about some positive work experience, which has emerged during the reorganization. However, it is impossible to say that this process is taking place evenly and smoothly, without obstructions and delays. We will talk about them in the second part of the survey.

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ATOMIC ENERGY INSTITUTE OFFICIAL INTERVIEWED ON S&T PROGRAM

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 6, Jun 86 pp 34-41

[Interview with Academician Valeriy Alekseyevich Legasov, first deputy director of the Institute of Atomic Energy imeni I.V. Kurchatov, winner of the Lenin Prize and State Prize, by PLANOVOYE KHOZYAYSTVO special correspondent A Chuvelev, under the rubric: "Problems of Scientific and Technical Progress": "Technological Tomorrow"; date, place, and occasion not specified; first paragraph is PLANOVOYE KHOZYAYSTVO introduction]

[Text] Academician V.A. Legasov, first deputy director of the Institute of Atomic Energy imeni I.V. Kurchatov and winner of the Lenin Prize and State Prize, answers the questions of our special correspondent A. Chuvelev.

[Question] The materials of the 27th CPSU Congress devoted much attention to problems pertaining to the national economy's broad assimilation of progressive technologies as one of the most important directions of scientific and technical progress. Valeriy Alekseyevich, how specific are these problems to our country?

[Answer] There are unquestionably aspects, which are specific to our country, in these technological problems. They are first and foremost associated with the diametrically opposing social consequences of the scientific and technical revolution in socialist and capitalist countries. Under capitalism, it causes increased unemployment, the greater exploitation of the working people and a number of other acute social problems. Under socialism, however, it promotes the steady rise of the people's material and cultural standard of living. Specific problems also stem from our country's history, geography and the location of its resources. Nevertheless, the technological restructuring that our country is presently experiencing with all the attendant consequences is also taking place in developed countries with other social conditions and will continue in the next few years. After all, very complex problems are developing everywhere and every country solves them in its own way. But the natural laws of the development of science and technology convey a common character to them.

The industrially developed countries are now faced with the problem of developing their productive forces on the basis of progressive technologies. Scientists believe that this process is comparable in importance with the

industrial revolution that started in the 16th and 17th centuries and that marked the beginning of the industrial stage in the development of mankind's productive forces. Like all its predecessors, it is a historically inevitable--generates a vast number of economic, social, technical, technological and other problems.

The question of competition arises under these conditions: those who get their bearings sooner and who enter the next stage of the scientific and technical revolution earlier will enjoy the greater gain; those who are late will experience greater difficulties. The socialist planned economy objectively has advantages in implementing large-scale scientific and technical programs. And now, as the 27th CPSU Congress emphasized, it is important to make the economic mechanism as receptive as possible to advances of scientific and technical progress. It is essential to find organizational forms for the integration of science, technology and production that will make it possible to ensure the rapid passage of scientific ideas from their origination to broad application in the national economy. The first steps in this direction have already been taken: the network of scientific production associations is being expanded; interbranch scientific technical complexes and centers are being created.

[Question] Then, Valeriy Alekseyevich, permit me to ask you the following question: In what way does the new approach to the development of science and technology differ from the conventional approach?

[Answer] In the process of solving problems of industrial development, mankind created models of equipment in nearly all directions of its activity and learned how to duplicate these models; mastered powerful energy systems and specific industrial types of transport: automotive, rail, air; communications systems: radio, telephone, telegraph, television; various kinds of electrical and electronic devices; computing and calculating systems; the science and technology of affecting the yield of crops using chemicals, and so on. The list could be continued for a very long time.

At the same time as the development of prototypes of equipment a search was also made for organizational forms of their duplication, in which, incidentally, mankind has been especially successful in the last two-thirds of the current century, when in the search for materials it extracted from the earth more than 90 percent of all the resources extracted in its entire history.

It is now clear to everyone, specialists and nonspecialists alike, that if mankind continues to increase the extraction and use of resources on the same scale as today, not 100 years will pass until it will be back, figuratively speaking, to square one. This is because in technical creativity to date the creation of functional devices with maximum emphasis on some one basic parameter, be it capacity, speed, or strength, for example, was always primary.

We are by tradition wont to believe that more powerful, faster or stronger is always better. Therein lies what is probably one of the basic distinctions of industrial development. The most important consideration in the technical

approach is not only the attainment of the maximum value of some basic functional parameter, but the way in which it is attained, how much its further increase costs, and whether its maximum is actually needed, in other words, whether it is optimal for the given conditions. Such an approach regulates the consumption of resources by eliminating senseless expenditures.

[Question] The question of crises arises in this regard. The energy crisis, the food crisis, the resource crisis. What black pictures were painted in the press just a few years ago! Now that the wave of such predictions has abated, specialists are seriously beginning to question the degree to which these names reflect the essence of the events and to ask whether these crises actually exist. What are your thoughts in this regard?

[Answer] I concur with those scientists who from the very outset maintained that none of the enumerated crises was of a resource-related, inevitable nature. The consequences of the existing mode of use of energy, raw material and other resources have periodically intensified given the wasteful mode of consumption that characterizes industrial production today; local shortages and high pollution levels, and soforth are also possible. If the consumption of resources is rational, that is, optimal, they will last for many millennia. The first reports of the energy crisis dating back 12-13 years ago following the first dramatic increase in oil prices by OPEC countries were probably the first warnings that it is impossible to use the planet's resources any longer in the existing manner, while the wave of research and development in the area of energy conservation, which originated in response to these warnings, marked the beginning of the new technological approach.

[Question] Thus, the crux of matter was not the shortage of oil in general, but that the method of its use was outmoded and that there was a need to find a new, significantly more economical method?

[Answer] Yes, and by way of proof I will illustrate this with several concrete examples. I will begin with energy problems. We are all fully aware that the efficiency of the best gas-burning electric power plants is roughly 40 percent; atomic power plants--33-34 percent. Thus, more than two-thirds of the extracted energy resources are lost in the process of generating electric power alone, thereby creating heat pollution problems. However, if we examine the entire cycle from the extraction of the energy resource to the final use of electric power on the part of the customer, it will become clear that the summary losses comprise a significantly larger quantity. Having extracted an energy unit of some energy resource from the earth, part of this energy (approximately 10 percent) must be allocated for extraction needs proper. About 10 percent is also lost in the next stage--the shipment of the energy resource to the electric power plant. As we know, another two-thirds of the energy are lost in the process of burning energy resources to generate electric power. The generated electric power is transported over power lines to the customer and another 10-12 percent is lost in the course of this process due to resistance heating. Further losses occur in the course of the distribution and consumption of energy. For example, the performance of three successive operations with a 0.9 efficiency in the devices used results in the loss of almost 30 percent of the energy that is transmitted for use. In the given instance, and it is typical, only about 10 percent of the extracted

energy resource will be converted to work; the remainder will heat up the atmosphere thereby creating ecological problems.

Thus the magnificent models of machines that have been created by mankind are based on a production technology that effectively utilizes less than 10 percent of the expended energy.

Another example concerns the expenditure of energy resources on the production of materials without which the existence of today's society is inconceivable: aluminum, steel, cement, oil, paper. We usually call attention to the comparison of indicators attained in the USSR and in foreign countries and we talk and write a great deal about the average lag of Soviet technology behind Western technology. However, if we look at the quantity of energy that must theoretically be expended to produce a unit of these materials, we will find that even in the case of the best Western technologies, the energy expenditure indicator exceeds the theoretical indicator: sixfold for paper; fourfold for steel; fivefold for cement; ninefold for oil; and 125-fold for paper! No scientist in the world, for example, can give today a formula of how, for example, to produce paper at a hundredth of the existing cost or expend one-fourth as much electric power to produce a ton of steel. This example shows how far modern production is from the ideal and what enormous reserves exist for its improvement. But, of course, this improvement will not be great given the evolutionary improvement of well-developed machinery. Other principles are needed.

[Question] In recent years the mass media have more and more frequently told about flexible machine systems, with which the creation of new technologies is associated. What are the reasons for the development of flexible machine systems and the growing interest in them?

[Answer] In order to answer this question, we must look at the way the life of the industrial systems producing a product and the life cycle of the product itself have changed during the current century. The life of industrial systems has been steadily rising as a result of successes in various areas of science and technology and currently averages 25-40 years compared with 2-5 years at the beginning of the century. At the same time product viability as changed in exactly the opposite direction.

At the beginning of the century, during the lifetime of the product in the marketplace, the machines producing the product might wear out and be replaced by new ones two, three or more times at the same time that demand for the given product continued. The average lifetime of products was calculated in decades, while the lifetime of the equipment that produced them was reckoned in years. Certain types of clothing and footwear were even handed down from generation to generation. Many types of machinery at that time could only with difficulty be operated continuously for several years. As time went by, however, the situation changed: the lifetime of the product in the marketplace gradually became shorter. Finally, in the 1960's, the average lifetime of production equipment coincided with the average lifetime of the product in the marketplace. Consequently, the equipment developed during that time served on the average as long as the commodity produced by that equipment was in demand on the market. Today, the market is increasingly flooded with

products with a lifetime less than 5-6 years given a life of the equipment of 25-40 years. It is clearly disadvantageous to reduce the demands on the equipment and to shorten its life. It is more rational to preserve the achieved service life of the equipment, but to make it more flexible, adjustable, and capable of producing various kinds of products as the need for them changes. The creation of such a flexible technology is one of the most important factors requiring the organization of production processes on the basis of other principles than those at present.

Biological living systems are unquestionably ideally flexible. And even though in them the processes of assimilation of various products differ, they organize ties between their individual elements in such a way that these processes can take place both individually and in parallel. Moreover, with the minimum expenditures of energy for the organism.

This can hardly be achieved in industrial practice. But modern science and technology is entirely able to make the production of various types of products less sensitive to fluctuations in the composition of raw materials, power supply and changing requirements. However, this requires a new approach: not merely manufacturing new machinery, but manufacturing it on a fundamentally new basis.

[Question] As we know, due to the unprecedented scale of production and consumption of raw material resources, the second half of the current century will be characterized by the strong concentration of production capacities in a single space, by the considerable increase in the unit capacities of machines and rigs. Will the process of consolidating enterprises continue in the future?

[Answer] The purpose of increasing unit power or the productivity of some unit is to reduce the unit cost of the output being produced. The higher the productivity, the cheaper the product. However, this thesis does not always hold true. Practice shows that every production facility and every unit has its own productivity level, the exceeding of which instead of a profit begins to produce losses. This at first glance paradox is explained very simply. When productivity reaches a certain high level, its further increase requires such significant outlays on the creation and maintenance of elements in the system that are no longer recouped by an increase in the quantity of output.

Thus, the further consolidation of works and plants at the existing technological level will occur only where the optimum has not been attained. When a new mode of production of any type is created, the value of its its optimum will also change. The existence of such an optimum is the first constraint on the unlimited consolidation of industrial plants.

The second constraint is the sharp increase in the accident rate with the consolidation of enterprises, especially in the chemical and petrochemical sectors. For example, between 1950 and 1980, the volume of production of petrochemical products in the United States increased 2.6-fold chiefly as a result of the enlargement of the unit capacity of plants, which increase on the average by three- to fourfold during that period. The result of such concentration of capacities was that even though the general accident rate in

this sector rose in proportion to the growth of the total production volume (threefold), the number of serious accidents involving human fatalities increased sixfold, while material damage due to the average accident in a year increased fourteenfold!

The indicated jump in the accident rate due to the concentration of production was connected with the presence of the enormous surpluses of raw materials and energy in technological cycles. This is one more direct indication of the need to alter the technologies of producing the majority of products we use.

Ecology is the third constraint on the consolidation of production and yet another factor that requires changing the approach to the technological organization of processes. Ecological problems are clearly the consequence of the unjustifiably large expenditure of various materials and energy in the production of the final product. These problems are well known and yet it is impressive when one reads that more lead has been discharged into the planet's air in the last decades than was discharged in all preceding history; more cadmium, copper and zinc--than in the entire first half of the century. The absolute figures on metals discharged into the atmosphere are quite impressive: lead--19 million tons; zinc--14 million; copper--more than 2 million tons. Of course, the need to reduce these effluents dictates other demands on technology.

[Question] Thus the obsolete methods for using the planet's resources should be replaced by more sophisticated methods for converting natural resources into final products. By what, in your opinion, will such technological restructuring be characterized?

There are several such indicators. I will try to dwell briefly on each of them.

First, directness. This means that scientific and technical progress affects all sectors of the national economy, all directions of human activity, and not only the main priority directions.

Second, the substantial reduction of the power-output and materials-output ratios. I think this is also clear without any additional explanation.

Third, the diversification of energy sources and energy carriers. Our society is presently entering a period in which different energy sources will be required for different technological purposes. For one--solar; for another--nuclear; for a third--oil, and so on. The time when energy supply problems were for the most part solved by a single energy source will sink into oblivion. The same also applies to energy carriers. Hydrogen and synthetic types of fuel based on it will replace natural fuels in many technological processes.

Fourth, synergism. Synergism is a phenomenon in which due to the interaction of several factors their mutual strengthening occurs and some new quality appears. In anatomy, for example, this term refers to joint, mutually strengthening actions of various groups of muscles. In its application to national economic activity, synergism means the creation of a system of

interacting production facilities--not separate chemical, power, extractive, metallurgical facilities, but rather facilities combined into a unified complex, the technological cycles of which are interconnected; that the power and raw material waste of some facilities can serve as a source of supply for others. It is specifically the creation of such energy technology complexes tha' will make it possible to realize the "wastefree" principle about which so much has been said and written of late that the word itself has taken hold, but the actual principle is not closer to realization as a result than it was when the word first appeared in the press. For some reason, it is erroneously assumed that some one, individual technology can be wastefree, even though the reverse is obvious. No technology can be wastefree, if this technology cannot be combined with another technology. for which its waste can serve as raw material. Such synergistic interaction of different technologies will inevitably create a new quality, namely the theoreticallt ecological safety of industry, because it does not presuppose planned discharges of waste into the environment.

Fifth, the considerable enhancement of the role of human factor. Let us illustrate this indicator with a single but quite convincing example.

The increase in the amounts of capital investments and in the size of the work force was until recently a basic factor in the grc th of the gross national product (GNP). Today, however, the picture looks different. In Japan, for example, only 11 percent of the increase in the GNP is secured by increasing the size of the work force, 41 percent--by modernizing the equipment inventory, and 48 percent--by improving the quality of the work force. As a result, almost half of the growth of the GNP of one of the industrially most highly countries in the world is attained as a result of the skill level, inventiveness, and other qualities of the personnel. The size of the work force can be increased and equipment can be replaced, but this will have little benefit for the state, if there are no skilled personnel capable of properly operating this equipment and tending these processes.

Sixth, the sharp increase in the scale of use of chemical principles and chemical processes in all sectors of the national economy.

After all, none of the major problems requiring solution today can be resolved without the wide use of chemical technology processes. The fulfillment of the Food Program and Energy Program and the development of information science are only possible on a chemical basis.

The increase of the yield of the fields, the proper storage of the harvested crop, and the proper development of the food industry require the production of fertilizers and weed and pest control agents. Enzymes for the production of organic and inorganic fertilizers will been needed on a larger and larger scale.

The Energy Program envisages the development of coal-based and atomic energy at an ever accelerating rate. The development of coal-based energy means a gradual several-fold increase in coal production. It is quite obvious that is it practically impossible to transport such an enormous quantity of coal from east to west, where its consumers are mainly located. It is technically

possible, but very uneconomical to burn coal at the place of production, to generate electric power and to transmit it over high-voltage power lines from east to west. What is more, the burning of coal on a very large scale in the same place will cause very serious ecological problems. Therefore, it is necessary to chemically process the mined coal at the site, so that the resulting energy-intensive chemical products could be transported by pipeline to the regions where the energy will be consumed. Thus, the chemicalization of coal processing can provide that part of the power engineering, which will be based on its large-scale use.

Nuclear energy is the leading component in the nation's future power industry. So that it would be reliable and economical and ensure the long-term development of our power industry, it is necessary to solve at least two problems. First, the transition must be made to fast reactors--to nuclear sources in which uranium-238 is transformed into plutonium, which will make it possible to use practically all the natural uranium for the production of energy. It is specifically on the basis of such nuclear sources that mankind can be truly be supplied with energy for thousands of years. The most essential elements of such a nuclear cycle are: the extraction of plutonium from spent nuclear fuel, the removal of radioactive fragments from it, and the use of chemical and chemical-metallurgical techniques to impart to plutonium the form of a fuel element that can be re-used as atomic reactor fuel. The scale and effectiveness of the use of nuclear energy will depend precisely on these key elements.

The second major problem is the burial of radioactive waste. For the most part this is once more a chemical or more precisely radiochemical problem that is associated with the need for the classification of various radionuclides, the selection of those that are useful to the national economy, and the reliable sealing of unneeded, harmful radionuclides in chemical forms of packaging for long-term storage.

Solar energy is also associated with the development of chemical technologies. In all combinations in case of the use of solar energy the development of energy accumulators will be required so that clear weather can be actively used for the accumulation of energy and a schedule of electric power supply can be balanced on cloudy days. Only chemical, electrochemical or thermochemical systems, which in their aggregate ensure the effective development of solar energy, can be such accumulators.

Thus, regardless of the path that is chosen for the development of the future power industry, the role of chemical technology processes and chemists in the realization of one or another direction of power engineering is very important, if not decisive.

A similar situation has also developed in connection with the prospect of development of the new sector of industry which is called information science. High-speed computers and microprocessors should be the technical basis of information science. They should be founded on an element base that does not presently exist. This element base with a high density of integration of elements should be the product of a very highly developed physicochemical process requiring the large-scale production of pure materials, their alloying

and the mobilization of their specific physicochemical features. Therefore, the production technology of the element base is essentially a new chemical process that should be quite economical.

Seventh, the broad use of physical means of working materials: plasma, laser, ion sources, accelerators. I shall cite the following example to illustrate their effectiveness.

As we know, most heating processes in various sectors of the national economy involve the removal of moisture. Moisture needs to be removed from fertilizer to prevent it from caking. By tradition the drying process is carried out in a granulation tower, in which all the material of the fertilizer is heated to a temperature of 200-260 degrees Centigrade, at which the separation and evaporation of moisture occurs. The process of heating an enormous mass of fertilizer naturally requires large expenditures of energy. At the same time a microwave heating technique has been developed and tested in our country. What are its specific features? Microwave radiation has the property to be selectively absorbed by individual elements of a medium. If fertilizer is exposed to such radiation with the proper wavelength, it will be absorbed only by moisture. The selective heating of moisture is therefore carried out very effectively. It makes it possible to reduce to one-fortieth to one-thirtieth (!) the expenditures in similar processes as compared with the traditional method of carrying them out. Only a "minor" thing remain--to introduce this progressive method into industrial practice in a shorter period of time. To date, however, it is used only in demonstration processes.

These are perhaps the basic indicators that, in my view, should characterize our entry into the technological age.

[Question] Valeriy Alekskeyevich, at the conclusion of our talk, permit me to address you as a member of the Presidium of the USSR Academy of Sciences. It is said that the technical state of our national economy and the lag that has appeared are to a considerable degree explained by the fact that the recommendations of the USSR Academy of Sciences are not sufficiently complete and regular. What are your comments on these points?

[Answer] First, I do not agree with regard to the technical lag of our national economy. We are not technically lagging, the lag in technology is appreciable. It is well known that the samples of domestic products, which have displayed at 11 international exhibitions, are frequently magnificent, but we do not always duplicate them at the proper service life level and do not introduce them in time and on the required scale.

As regards the Academy of Sciences, in my opinion it should answer for the integrity and development of the nation's intellect. Therefore, the Academy of Sciences needs to be criticized when it does not maintain that level of intellect.

If the Academy of Sciences is overburdened with complex scientific, technical, and applied problems, no great benefit will be forthcoming. The Academy should, for example, provide general algorithms for the solution of problems, principles for developing materials technology and prototypes of new

materials, the logic of the development of information science, and so forth. In this direction its recommendations should be heeded by practice and by production organizers in order to understand the processes taking place in science, and the perspectives of technology. But it is the proper use and introduction of these recommendations that is the business of the USSR State Committee for Science and Technology, USSR Gosplan, sectorial ministries, and the collectives of production associations and enterprises.

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PROBLEMS OF PLANNING NEW GENERATIONS OF EQUIPMENT

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 6, Jun 86 pp 42-49

[rticle by V. Simakov, chief of a department of the USSR State Planning Committee, and Doctor of Economic Sciences Yu. Yakovets: "New Generations of Equipment: Planning Problems"; capitalized passages published in boldface]

[Text] The strategy developed at the 27th CPSU Congress for managing the acceleration of scientific and technical progress is based on the realization of three basic tasks. The first of them is the concentration of resources in the key directions of science and technology; the second is the mass use of reliable, practically tested technical innovations; the third is the acceleration of research, design and engineering development of new generations of equipment, technology and materials (hereafter in the text "equipment"), which increase labor productivity many fold and reduce the power- and materials-output ratio.

The last task is integrally connected with the radical improvement of the management of the nation's scientific and technical potential. Its accomplishment will require new methods of planning scientific and technical progress. The transition to the planning of the development, assimilation and application of new generations of equipment, as a rule, in the form of machines and complexes of production equipment that satisfy the national economy's needs for them is the basic element of newness. It is stipulated that each new generation of equipment ensures significant effectiveness of the materialization of scientific advances, expands the functional potentials, and improves the quality of the output being produced.

The optimal management of the scientific and technical potential is a most important component part of economic management. It is called upon to promote the creation and broad introduction of new generations of equipment and depends on the aggregate of manpower, material and financial resources, as well as the factors (the amount of knowledge and information, the level of organization of production and labor, management) that society has at its disposal for attaining long-range goals in the area of scientific-technological progress.

The management of the scientific and technical potential presupposes the implementation of management decisions and planning and organizational measures that envisage:

—the determination of the basic directions and programs for the development of science and technology on the basis of a long-range model of generations of equipment with due regard to the nation's needs under the conditions of projected new discoveries and major inventions in basic and applied sciences;

--the creation, improvement and concentration of resources in key directions of scientific and technical progress, the development of the network of scientific research and pilot production bases, including interbranch scientific technical complexes, and the development of systems of machines and technologies, which correspond to the predicted generation of equipment.

The effectiveness of the management of the scientific and technical potential is ultimately characterized by the rate and volume of introduction of the most important advances of science and technology and the forms and methods of their organization in both the scientific and production sphere. Intensification of the creation of machines that exceed or correspond to the world level can be based only on the leading comprehensive development of the scientific and technical potential and the concentration of resources in the key directions and basic stages of cyclical modernization of generations of equipment.

The "generation of equipment," the "system of machines," and a number of other concepts came into wide use in the economic literature comparatively recently. Let us define their place with regard to the acceleration of scientific and technical progress. A new generation of equipment is a system of machines (objects of labor, machinery, production processes, and so on) that uses a new theoretical idea (discovery or major invention), which makes it possible to surpass (or reach) the world level and to increase the effectiveness of production many fold.

The system of machines consists of a multitude of elements (technical means) that are related to and are connected with one another according to a certain law or principle. The basic features and characteristic trains of a system of machine are the existence of:

—goals of functioning that are attained by the simultaneous, consecutive or parallel execution of specific tasks by technical means interconnected with regard to productivity;

—management that constitutes the process of the purposeful influencing of the machines belonging to the system, which ensures its effective functioning and adaptation to the influence of the external environment;

--a hierarchical structure of the system, which consists of several levels (subsystems of machines and elements of technical means), which in turn can be regarded as systems of machines, which include subsystems (elements) of a lower level;

--the process of the functioning of a system of machines, which consists in the effective attainment of the given goals and in the exchange of various material resources and information between its elements.

The periodic change of generations of machines can be seen in any sector of the national economy: this is the primary and most common form of manifestation of the cyclical development of science and technology. The full LIFE CYCLE of generations of equipment includes five most typical phases: development--assimilation--dissemination--maturity--obsolescence, with a total duration of 15-20 years). The PERIODICITY of the change of generations of equipment is roughly one-half of this period, since the last one or two phases of the preceding cycle coincide with the first two phases of the following one.

Under present conditions the extensive introduction of new generations of equipment and the reorganization of the structure of production are occuring, the pace of scientific, technical, economic and social progress is increasing. The structure of the priority directions of the development of science and technology is also appearing: the leading role belongs to microelectronics, to biotechnology, to the creation and broad introduction of energy-saving and waste-free technologies, to flexible production systems, and to the rapid development of robotics. The reorganization also affects the nonproductive sectors, the personal consumption sphere, the management of the national economy and national defense.

Under these conditions, the acceleration of the creation of new generations of equipment and the satisfaction of society's need for it is the content of the unified scientific and technical policy, especially the planning and management of scientific and technical progress. The development of new organizational and economic forms of the planned management of this process is necessary. As a result, it will become possible to purposefully form new technological systems based not on individual, separate types of machines, but on a system of machines that ensure the automation and robotization of production. This will alter not only the technical base of production, but also its organization, the methods of management, and the character of social labor. Technological systems make it possible to proceed to the group method of processing objects of labor, which considerably reduces the labor-intensiveness of production and imposes higher demands on the stability of technological processes.

The acceleration of the pace of scientific and technical progress is possible only on the condition of a high degree of readiness of the scientific and technical base and the production base for the rapid increase in the volumes of work on new generations of equipment.

Cited below is a qualitative model of generations of equipment, which was developed and tested as a system of long-range analysis of the development of technology. It is the aggregate of features that most completely reflect the functional, design, and technological indicators of equipment that has been or is being created with the use of basic and applied scientific and technical achievements in the forecast period of time. Here the functional, design, and

technological features of generations of equipment are regarded as interdependent and interconditional.

The key qualitative features that provided the basis for building a model of generations of machinery were identified and classified over a period of several years.[1] The concept and definitions of the "generation of equipment" were developed and designated (in addition to directive, standard technical, and other procedural documents) for use in the process of managing the development of equipment, including when evaluating the scientific and technical level of products at various stages of the life cycle (in the organization and performance of basic research and exploratory work, in the process of research and development), at the stages of tests and series production; for the selection of baseline products in the directions of technology; when formulating the design assignments for retooling and the assimilation of new production capacities; when formulating the basic directs and scientific and technical programs of the comprehensive development of science and technology and when training personnel.

As it follows from the cited system, second-generation equipment is characterized by only 8 qualitative attributes; third-generation--by 14; fourth-generation--21; fifth-generation--28; and sixth-generation--34.

The qualitative model is limited to six generations of equipment, which, according to expert estimates, corresponds to the time interval up to the year 2005. In order to realize the sixth generationof equipment, it is even now necessary to perform basic research for the purpose of ensuring the complete solution of scientific and technical problems, developing advanced technological processes, fundamentally new materials, and so on.

The transition to each successive generation of equipment presupposes the continuous improvement of all its attribute that were assimilated in preceding generations. Classifications of items by generations are based on the comparison of their functional, design, and technological attributes.

The determination of generations of components, materials and special devices, which are included in machinery and apparatus, is made in accordance with their affiliation with equipment of the corresponding generation.

The classification of the most important attributes of various generations of equipment will be incomplete, if we do not consider so-called PSEUDO-NEW SOLUTIONS, the need for the detection of which is presently very urgent. Therefore, THE CAPACITY TO ENSURE A DRAMATIC INCREASE OF THE QUALITY, TECHNICAL LEVEL, AND PRODUCTIVITY OF SOCIAL LABOR is the integral technical and economic substantiation of the assignment a developed item to a new generation of equipment. Precisely the need to encure a real and substantial reduction of the labor-intensiveness, materials-output ratio, and energy consumption and to increase the reliability of the items being developed and the efficiency of their functioning has been made the basis for the identified aggregate of attributes of models of generations of equipment.

Qualitative Model of Generations of Equipment

	Qualitative features	Generation of equipment: Second	Third	Fourth	Fifth	Sixth
Functional	Level of automation of control in systems					Teaching systems w/artistic, intellectual features
					Flexible programmable systems w/adaptation & internal diagnostics	
				Totally automated systems w/adaptation to external influences		
			Automated control systems			
		Semiautomatic control				
	Level of of automation of control in apparatus					Automatic control w/elements of artificial intelligence
					Adaptive automated programmable control	
				Automated control w/adaptation to external influences and self-diagnostics		
			Automated control of individual devices			
		Semiautomatic and manual control				
Constructive	Computer technology				Supercomputers, multisystem networks	
				Microprocessors, microcomputers (programmable controllers), built-in local networks		
			Minicomputers (peripheral), local networks			
		Second generation computers (central), multiprocessor systems				
	Functional electronic devices (functional integration)					Bionic functional systems
					Multifunctional devices	
				Functional devices		
	Electronic devices (degree of integration (el/cryst)					Integrated systems
					Integrated circuits (10^5-10^6)	
				Integrated circuits (10^4)		
			Integrated circuits (10^2-10^3)			
		Discrete elements				
Technological	Technology of creation of a programmed product					Teaching programming systems
					Programming systems in a single high-level language	
				Automated programming technology with high-level languages		
			Package programming with high-level languages			
		Programming in machine codes and with algorithmic languages				
	Equipment & systems for the design, production and monitoring of products					Teaching design, production & monitoring systems
					Integrated design, production & monitoring systems	
				Integrated automated design, production & monitoring systems		
			Automated design, production and monitoring systems			
		Equipment for automating individual design, production and monitoring operations				

The steady tendency for the obsolescence of the qualitative attributes and characteristics of items to speed up continues under the conditions of rapid rates of scientific and technical progress. Consequently, in addition to commonly accepted evaluations of product quality, it is advisable to introduce the concept of the scientific and technical level of items, which determines the degree of their correspondence to the current or forecast generation of equipment.

The development, assimilation, and dissemination of new generations of equipment should become the basis of the system of comprehensive planning of scientific and technical progress at the national economic, sectorial, and territorial levels. The creation of such a system is envisaged in the Basic Directions of USSR Economic and Social Development for 1986-1990 and the Period to 2000, which were approved by the 27th CPSU Congress. It posed the task to make the transition to the comprehensive planning of scientific and technical progress and to take the necessary steps so that plan assignments would be based on advances of scientific and technical progress and would promote the development of every sector on the basis of the broad application of new equipment and technology.

The basic principles of the comprehensive planning of scientific and technical progress are the following:

--the coverage of all stages of scientific and technical progress--the development, assimilation, dissemination, and use of new generations of equipment--which makes it possible to optimize the duration of scientific and technical cycles, the time of the changeover of generations of equipment, to eliminate the gaps between individual stages, which result in considerable losses of time and effect;

--the assurance of the harmonious interaction of all participants in scientific and technical progress--vertically (by levels of planning and management--from the national economic to the local level) and horizontally (developers, producers, users, related sectors, and so on). As a result departmental barriers and the lag of coordination of various units are eliminated;

--the coverage of all types of plans (long-term, five-year, current), scientific and technical programs, and long-range retooling plans. This ensures the aggregation and disaggregation of plan assignments, indicators, and norms with regard to planning horizons and levels, the increase of the impact of the plan on the acceleration of scientific and technical progress, the unity of the sectorial, territorial, and program planning of scientific and technical progress;

--the combination of centralized plan assignmments on the development, production, and application of new generations of equipment with the independence, initiative and responsibility of scientific research institutes, scientific production associations, and production associations (enterprises) with the system of long-term economic contracts between all participants in the process of the development, assimilation, production and utilization of new generations of equupment, which provide for the division of the obtained

effect among all participants and strict sanctions for the nonfulfillment of contracts;

--the increase of the competitive ability of domestic equipment, the exceeding of the world level, the development of scientific and technical cooperation and direct relations relating to the joint development, assimilation, production, delivery and servicing of equipment of new generation in the process of implementing the Comprehensive Program for the Scientific and Technical Progress of CEMA Member Countries to the Year 2000;

--the attainment of the highest national economic effectiveness of new generations of equipment, which ensure the many-fold increase in the productivity of social labor, the improvement of product quality, and the saving of production resources. The system of the planning, economic stimulation, and management of the development and the satisfaction of the national economy's need for new generations of equipment is still in the formative stage.

Among the basic directions of its formation there are first of all the long-range forecasting of the development of science and technology and the identification on this basis of regularities of succession of generations with the breakdown of complexes of interconnected sectors of the national economy by priority directions of technology. This requires a long time (15-20 years), which makes it possible to plan the interconnected development of generations of machines, which succeed one another, and the priority directions.

The forecast cannot be limited to any one narrow sector. The transition to a new generation of equipment encompasses a number of interconnected sectors of the national economy. For example, the formation of a new generation of industrial robotic complexes demands, in particular, the use of programming systems in a high-level language, qualitatively new multifunctional sensory devices, high quality materials, as well highly effective technological areas of application and the special training of personnel who capable of developing and using integrated design, production and monitoring systems.

Thus, it is a question of a system of forecasts and programs of various levels, which are integrated when formulating the 20-year Comprehensive Program of Scientific and Technical Progress, which is revised and extended every 5 years and is closely associated with the analogous program of CEMA member countries, as well as with the programs of interbranch scientific technical complexes. The basic assignments on the elaboration of the scientific and technical program in the priority directions of development of science and technology and the generalizing forecase indicators of scientific and technical progress, which fundamentally influence the growth of labor productivity and the saving of material resources, should be the end result of such a system.

Scientific and technical programs are the main tool for concentrating resources on the rapid development of priority directions and the new generations of equipment, which are being developed. The formed hierarchical system of the most important programs includes 5 directions of the

Comprehensive Program of Scientific and Technical Progress of CEMA Member Countries (the electronization of the national economy; total automation; atomic energy; new materials and technologies of their production and processing; biotechnology), 16 programs on the directions of activity of interbranch scientific technical complexes, and 50 all-union scientific and technical programs. This system is also being implemented on the territorial level with allowance made for the peculiarities of the scientific and technical potential, structure, and prospects of development of the region. In each of them it is advisabe to have an integrated program like the Leningrad Intensification-90, the Sibir Comprehensive Program, the unified Efficiency and Quality Scientific and Technical Program, which is being formulated for Moscow, and other.

The goal of the management and planning of research and development is the creation of a baseline generation of equipment at a given point in time, by the comprehensive accumulation of knowledge and information about the forecast nature of item in the process of scientific inquiry and the intensive concentration of the necessary resources for its creation. The subsequent development of the scientific and technical potential takes place with due regard to the gained experience and the established mechanism of the achievement of goals.

The complex of programs should be regarded as a directive goal program document, which ensures the coordination (with respect to resources, performers, deadlines) of scientific research, economic and organizational assignments, and measures aimed at the solution of scientific and technical problems.

The combination of the existing structure of the administration of ministries and departments with the system of the goal program management of the scientific and technical level and quality of the new generations of equipment, which are being developed, as well as the rights and responsibility of chief designers and managers of the main scientific research institutes and the design bureaus of the interbranch scientific technical complexes and scientific production associations pursues the goal of strengthening the role of planning and economic organs in long-range planning (especially at the highest levels of management) and of freeing the local levels of management from petty wardship. Programs should be formulated with allowance made for the interrelationship with related sectors, interbranch scientific technical complexes and directions of priority research of the Comprehensive Program of Scientific and Technical Progress of CEMA Member Countries.

The inclusion of assignments of scientific and technical programs in five-year and one-year plans and their priority special-purpose resource supply are the actual realization of the decisive role of programs in the restructuring of proportions and the structure of production. Naturally the programs can encompass only part of the resources of the plan, but precisely they determine the acceleration of economic growth and the intensification of the economy. Therefore, in the plan indicators, norms and balances the attention of planning and economic organs should be focused on the implementation of programs and the obtaining of the maximum economic effect.

The evaluation of the full national economic effect of introducing new generations of equipment merits special attention. It should encompass not only the direct economic effect, but also the additional effect that is associated with the saving of public consumption funds, with the improvement of working conditions and with the foreign economic, technical and other types of effect.

The examined method of planning scientific and technical progress and the transition to the planning of the development, production and utilization of new generations of equipment have already been partially realized in the annual plan for 1986, as well as in compiling the plan for 1986-1990. In particular, the basic assignments on the solution intersectorial scientific and technical problems and the development of fundamentally new equipment and technology are included in the State Five-Year Plan (the "Science and Technology Development" section). This will make it possible to orient ministries and departments, and in subsequent stages, complexes of the national economy as well, toward the fulfillment of the assignments on the development and production of new generations of equipment of the highest world level.

A unique feature of the State Plan of USSR Economic and Social Development for 1986-1990 is the comprehensive inclusion of indicators of scientific and technical progress in its basic sections and the strengthening of their influence on the final national economic results. A three-level (national economy-complexes of sectors-sectors) system of comprehensive indicators of scientific and technical progress, that strengthens the connection between planned assignments and the indicators of the effectiveness of social production has been introduced; the advanced formulation of the sections of the plan on the development of scientific and technology as compared with the other sections of the plan has been carried out. This contributed to the more complete identification of the role of factors of scientific and technical progress in the growth of labor productivity, in the reduction of the product cost and in the saving of material resources.

Productive fixed capital is slated to be modernized at an accelerated rate on the basis of the priority allocation of capital investments in the technical retooling and reconstruction of existing production. Their share in capital investment in productive construction throughout the national economy as a whole by the end of the five-year plan will reach the 50 percent mark. New machinery, equipment and instruments in 1990 will be 13 percent of total machine building output.

The 12th Five-Year Plan calls for the production of more than 7000 rotary and rotary-conveyer lines. They will increase labor productivity 5-10-fold, reduce the need for production floor area to between one-third and one-half of the present level and reduce internal transport to one-fifteenth of the present level.

More than 35 new production processes based on self-propagating high-temperature synthesis (SVS technology) will be assimilated. They will find application in the production of powders of refractory inorganic compounds, ceramics, composites, and abrasives. Technology created by Soviet scientists

reduces material costs to one-fourth and one-third and capital expenditures to one-fifth and one-third (compared with the existing modes). To date more than 300 compounds have already been synthesized, production based on this technology will grow more than fifteenfold and will be widely applied at enterprises of the Ministry of the Electrical Equipment Industry, the USSR Ministry of Nonferrous Metallurgy, and the Ministry of the Machine Tool and Tool Building Industry. It is estimated that the economic effect during the 12th Five-Year Plan will be approximately 200 million rubles. The interbranch scientific technical complex of the USSR Academy of Sciences was created for the supervision of the work on this problem.

The plan envisages measures for improving the organization of the management of scientific and technical progress in sectors of the national economy and the strengthening of the integration of sectorial science and production through the creation of new and the improvement of the structure of existing scientific production associations. With the formulation of master charts of management during the 12th Five-Year Plan 60-70 percent of the sectorial scientific research, design and technological organizations will be included among scientific production and production associations and enterprises.

The work on improving economic methods of managing science on the basis of the standard planning of its resource supply will be continued during the 12th Five-Year Plan. The standards of deductions to the unified fund for the development of science and technology, which are established by the plan, make it possible to form in the sectors of industry funds for financing work on the development and assimilation of new equipment.

The concentration of resources and organizational efforts in the planning and large-scale production of new, highly effective generations of equipment, which exceed or correspond to the world level, is the central link in the realization of the tasks posed by the 27th CPSU Congress relating to the cardinal acceleration of scientific and technical progress.

FOOTNOTE

1. This is described in detail in the articles: V.V. Simakov, "Microprocessor Technology--The Basis of New-Generation Apparatus," SREDSTVA SVYAZI, No 1, 1981; V.V. Simakov, "Improving Methods of Managing NIOKR on the Basis of a Qualitative Model of Generations of Equipment," UPRAVLYAYUSHCHIYE SISTEMY MASHIN, No 1, 1986.

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NOVOSIBIRSK INSTITUTE OF ELECTRICAL ENGINEERING

Moscow EKONOMICHESKAYA GAZETA in Russian No 36, 1986 p 15

[Article by Professor A. Kozachok, prorector for scientific work of the Novosibirsk Institute of Electrical Engineering, under the rubric "The Efficiency of VUZ Science": "We Are Forming Educational Scientific Production Complexes"; first two paragraphs are VOPROSY EKONOMIKI introduction]

[Text] The quality of the training of highly skilled specialists depends first of all on the uniting of the efforts of higher educational institutions with production and scientific institutions and the joint use by them of the scientific and technical potential.

Institutions of the Siberian Department of the USSR Academy of Sciences, numerous sectorial scientific research institutes, and large industrial enterprises and associations are concentrated in our city. And it would be unwise not to use this enormous potential when organizing the educational process.

During the years of the past five-year plan our institute, for example, introduced 334 completed works with an actual, and not a conditional, economic impact which exceeds 42 million rubles. The volume of themes, which are of state, sectorial, and intersectorial importance, increased by 20 percent and came to 85 percent of the total amount of scientific research work. Its quality increased appreciably.

How was it possible to achieve this?

On the basis of our own experience we became convinced long ago that instead of narrow chair thematic groups, which are traditional for higher educational institutions, it is necessary to establish scientific collectives of staff members of a wide range of specialties.

For example, the idea of the organization on the basis of chairs of the radio engineering type of a unified scientific laboratory of radio engineering devices completely justified itself. As a result it was possible to get rid of work on minor themes, to increase substantially the significance of scientific research for practice, and to undertake major developments. While the close contacts with specialists of sectorial organizations made it

possible to introduce immediately in production more than 90 percent of the jobs performed by the laboratory.

A scientific laboratory of eletromechanical systems of the reproduction of motions was organized under the Electric Drive and Automation of Industrial Plants Chair with the participation of specialists of other chairs. It developed quite rapidly and at a high level an entire set of equipment for NC machine tools. The highly efficient unitized electric drive, which was developed here, includes electromechanical modules, semiconductor converters, control systems, and a specialized computer with complete software. It is intended for machine tools like the "machining center."

Comparative analyses and numerous departmental and interdepartmental commissions established: this system is at the level of the best foreign analogs, while with respect to a number of essential parameters surpasses them. Moreover, the performance of the machine tool is increased by more than 3.5-fold, while the labor intensiveness of its production is reduced to one-third.

Is it good? Unquestionably. But (however paradoxical this is!) the development was so new that it proved to be under the influence of the "braking mechanism" which had formed over the years: there is no base for the production of not only the production prototype, but also its assemblies. And even when with the assistance of the Novosibirsk Oblast Party Committee it was possible to organize the assimilation of a portion of the equipment at the Tyazhstankogidropress Production Association and to set up the small-series production of the EMP-8 and EMP-12 electric drives, neither this association nor the Ministry of the Machine Tool and Tool Building Industry, as it turned out, is able to assimilate the entire system as a whole.

What are the developers to do? To say the customary thing: we, they say, did our part, while it is not our concern there? If the Ministry of the Machine Tool and Tool Building Industry does not have enough forces, let it seek a way to involve in this work other ministries, particularly the Ministry of the Electrical Equipment Industry and the Ministry of Instrument Making, Automation Equipment, and Control Systems. But time passed, the development laid about, while analogous equipment, as before, was purchased from firms of the FRG and Japan.

We began to knock on literally all doors, until we succeeded in getting a joint order of the minister of the machine tool industry and the RSFSR Minister of Higher and Secondary Specialized Education on the establishment of an educational scientific production center (UNPTs) on the basis of our institute and the Novosibirsk Tyazhstankogidropress Production Association. Five Novosibirsk enterprises of the Ministry of the Machine Tool and Tool Building Industry were also included in it.

The ice had as if been broken. The ministers approved the plan of work of the educational scientific production center for the current five-year plan. It includes three main sections: the training and advanced training of personnel, scientific research work, and introduction in production. We also

submitted a proposal on the transfer of one of the plants of the city for the establishment of a pilot experimental base under this work.

Like many other higher educational institutions, our institute is concluding comprehensive contracts with large industrial enterprises. We have been cooperating for a long time and fruitfully with several enterprises of Novosibirsk. One of them is the Sibtekstilmash Plant, where of the many directions of joint work there is one that is most important: the improvement of the loom like the STB, the increase of its capacity and reliability, the broadening of the technological possibilities, and, hence, the increase of the quality of fabrics.

Here we are also adhering to the comprehensive approach to the solution of the problem and are trying to focus on them the efforts of staff members of several chairs and production workers. Scientists of the Chair of Applied Mechanics, for example, developed and jointly with plant workers implemented effective methods of increasing the capacity of the loom with an annual actual economic impact of more than 32 million rubles. The developments of scientists of the Chair of Machine Building Technology on the thermoelectrophoretic method of hardening critical parts of the loom were also adopted. As a result the wear resistance of the contact surface of parts was increased by 2- to 3.5-fold, which is yielding an annual economic impact of more than 240,000 rubles.

Finally, scientists of the Novosibirsk Institute of Electrical Engineering developed an electronic weft controller of breakage of the thread—the ancient dream of all weavers of the country. It has undergone tests at a number of textile enterprises of the country, while its series production has been started in Cherkassy.

There are many such examples. But it is a matter not only of their number. It is especially important for us that students are actively participating in this scientific research and development, while a portion of them after graduating from the institute go to the plants, for which the institutes conducted the scientific research.

In our opinion, it is necessary to grant higher educational institutions the right to assign 20-25 percent of the graduates through direct relations with enterprises. It is impossible to do this centrally—through the USSR State Planning Committee. It is only important whom we will send to labor collectives. I have already stated what impact integrated interchair associations yield. Perhaps, following this pattern multiple-skilled brigades of graduates should be formed and sent to enterprises, that is, the so-called modular principle of assignment, which, incidentally, is recommended by the RSFSR Ministry of Higher and Secondary Specialized Education, should be implemented. But it is necessary to do this significantly earlier, in order to enable the collective to work jointly for 2-3 years on technical problems. It is necessary to train like-minded specialists already from the undergraduate years.

It is impossible not to note that VUZ science is in great need of close contacts with academic science. The chairs of our institute for many years

have been working jointly with institutions of the Siberian Department of the USSR Academy of Sciences.

A system of lasting and long-term relations, which now encompasses practically all aspects of activity: the educational process, scientific research work, the quality of its fulfillment, and introduction into practice, formed as a result.

These relations have been consolidated by a contract on cooperation, which was approved by the chairman of the Siberian Department of the USSR Academy of Sciences and the RSFSR Minister of Higher and Secondary Specialized Education. The contract envisages mutual measures in the area of the organization and improvement of the educational process and the training of engineering personnel and science teachers and joint research and use of the material and technical base. Such a basis is making it possible to obtain good results.

For example, a geophysical measuring and computing complex, which ensures the gathering, recording, and online processing of information directly under field conditions, was developed by the joint efforts of scientists of the Novosibirsk Institute of Electrical Engineering and the Computer Center of the Siberian Department of the USSR Academy of Sciences. This decreases the time and expenditures when performing geophysical operations, especially in hard to reach regions of Siberia. The research, which is being conducted by the Novosibirsk Institute of Electrical Engineering jointly with the Institute of Inorganic Chemistry of the Siberian Department of the USSR Academy of Sciences, on the development of a new class of means of measurements on the basis of superconductivity is very promising.

Much work is being performed within the Sibir Comprehensive Program. Thus, academic laboratories for the problems of roadless transport for Siberia and the north, the hardening of metallic alloys, and the increase of the service life of parts and components under Siberian and northern conditions were established within the scientific research sector of the Novosibirsk Institute of Electrical Engineering by an order of the Presidium of the Siberian Department of the USSR Academy of Sciences. Here we can already speak today about specific results of such cooperation. On the basis of a test model of a general-purpose skimmer the design of a production prototype, which is intended for travel over water, snow, and swamps, was developed. It was successfully tested in Surgut.

I want to emphasize that the close contacts with academic science and industrial enterprises enabled us to get to the stage of the formation of educational scientific production complexes (UNPK's), which ensure the special-purpose training of skilled engineers with thorough theoretical and practical knowledge of the latest achievements of science and technology. Such a complex, in particular, is operating on the basis of the Aircraft Building Faculty of our institute, the Institute of Theoretical and Applied Mechanics of the Siberian Department of the USSR Academy of Sciences, the Novosibirsk Aircraft Plant imeni V. Chkalov, and several scientific research institutes. All the educational, scientific, and production work of students within the educational scientific production complex is organized on the basis of the personnel potential and the material and technical base of all its

members. It is not surprising that the graduates, who underwent training here, are successfully working at the works, at sectorial scientific research institutes, and in academic science. As a rule, problems of the adaptation of the graduate at the enterprise do not arise, the introduction of completed scientific jobs is sped up significantly.

This matter is promising, but for the present its development is being checked due to the lack of the necessary organizational, legal, and economic support. Now everyone for the present is inventing what he can, in each department there is its own understanding of the question. Of course, this is not conducive to the normal work and the evaluation of the activity of such creative associations. It seems that it is necessary to specify the positions and to support the activity of educational scientific production complexes with the necessary standard documents.

7807
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INTRODUCTION OF ADVANCED RESOURCE-SAVING TECHNOLOGIES

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 6, Jun 86 pp 50-55

[Article by Doctor of Technical Sciences Professor B. Rayzberg, chief of a department of the Scientific Research Institute Economics attached to the USSR State Planning Committee: "The Introduction of Advanced Resources-Saving Technologies"; first paragraph is PLANOVOYE KHOZYAYSTVO introduction; capitalized passages published in boldface]

[Text] Restructuring of production processes. Reserves for introducing new technologies. The problem of interbranch technologies. Technological specialization. Role of the plan in technological progress.

The implementation of the policy outlined by the 27th CPSU Congress of the acceleration of socioeconomic development, the intensification of social production, the increase of the technical level and quality of output, and the efficient use of the economic potential is closely associated with technological progress. The Basic Directions of USSR Economic and Social Development for 1986-1990 and the Period to 2000 call for the broad introduction of fundamentally new technologies--electron-beam, plasma, pulse, biological, radiation, membrane, chemical, and others--that enable the national economy to increase labor productivity many fold, to utilize resources more effectively, and to reduce the power- and materials-output ratios of production.

Advanced technology is the high road to the improvement of product quality. Quality is naturally influenced by the properties of the natural raw material. Nevertheless, it is guaranteed for the most part by the way the primary material is processed. The type and conditions of processing, the content of the operations entailed in transforming matter and energy into the final product, and the observance of the production routine and regulations are the primary conditions of obtaining at the output the requisite consumer properties which characterise the potential of making effective use of the item in accordance with its intended purpose.

Each technology predetermines a certain aspect of the quality of the product, material, and item produced on its basis. Thus, casting and plastic deformation are "responsible" for the observance of form; machining and welding--for precision, surface finish, and matching of dimensions; heat

treatment—for physicomechanical properties; biotechnology—for nutritive and other consumer properties; food technology—for gustatory qualities.

During the 12th Five-Year Plan a twofold increase in the output of products of the highest quality category is envisaged. This is impossible without an improvement in technology.

Only technological processes, the use of which ensures the production of products of the highest quality category, which correspond to or surpass the achievements of the world level, can be considered advanced. Such a condition should be made the basis for certifying and evaluating the progressiveness of the introduced technologies.

The influence of technology on quality will be effective only when it embraces all stages of production activity and the entire chain of operations in the production of a product or the performance of a job. This means that technological improvement should be extended to the entire cycle of obtaining raw materials, materials, semifabricated goods, components, and the final product, since the insufficient level of any element in the cycle ultimately compromises product quality. At the same time, the progressive character of the technological process of manufacturing a specific type of product is determined by the high technical level of all sequentially performed operations, including preparatory and basic operations, primary roughing and finishing, and operational development.

Under the conditions of the intensification of social production, technological modernization, which promotes resource conservation, becomes the basic direction of its improvement. In practice this means the replacement of obsolete technologies by more advanced technologies, the introduction of fundamentally new methods of converting matter, energy and information, which promote the high quality of the final product while reducing its specific labor-, materials- and power-output ratios.

The Basic Directions of Economic and Social Development provide that 75-80 percent of the increased need for fuel, energy, raw materials and materials by the year 2000 would be satisfied by their conservation. For this purpose it is necessary to reduce the power-output ratio of the national income to at least five-sevenths and the metal content to nearly one-half, to use of natural and material resources completely, to eliminate losses and irrational expenditures to the maximum, and to achieve the extensive commitment to the economic turnover of secondary resources and by-products. During the 12th Five-Year Plan the significant saving of all types of material resources and the reduction of their losses on the basis of the rapid transition to resource-saving and waste-free technologies are planned. By means of these measures will 200-230 million tons of standard fuel and 12-14 million tons of rolled ferrous metals will be saved in 1990 as compared with 1985. All this requires large-scale technological transformations in social production.

The restructuring of the technological process of machining in machine building and other sectors of the national economy is necessary. At present the cutting of metal predominates, as a result of which approximately 15 percent of it ends up as shavings and chips. The overall share of

production waste of ferrous metals in machine building is presently about 24 percent. It is also necessary to bear in mind the additional consumption which stems from the higher (by approximately 25 percent compared with the best world models) specific structural metal content of domestic machinery and equipment per unit of leading parameter. This point was discussed in detail at the production conference, which was held in June 1985 in the USSR State Planning Committee and was devoted to the tasks of improving the planning of the saving of material resources.

Metal can be machined by highly effective, economical cold and hot plastic deformation, extrusion and stamping techniques especially in the preliminary roughing processes. This reduces waste by 5-7 percent on the average and makes it possible to closely approximate waste-free technologies. Cutting must be employed only in finishing and sizing operations, thereby reducing the conversion of valuable structural materials into shavings and chips.

The fabrication of parts using powder metallurgy methods and machining of metals and the production of parts with complex configurations based on the superplasticity effect and, under certain conditions, nondestructive deformation, are still more advanced from the standpoint of metal conservation.

The reserves of the saving of materials are particularly considerable in the production of blanks. In case of the obtaining of blanks by the method of precision casting, extrusion, and pressing and the production of load-bearing components by advanced welding techniques it is possibl to save a large amount of valuable material and to reduce the metal content of items.

A vast set of technological measures, which ensure the economical use and saving of metal, is envisaged by the comprehensive program of the reduction of the materials-output ratio, which is being formulated by the USSR State Planning Committee.

Metallurgy has vast and far from utilized possibilities for improving technologies which are connected with the further expansion of the use of continuous steel casting processes, with the use of the fourth conversion, with the cokeless production of metal, and with the oxygen blast process. The assimilation of advanced processes for producing quality steel with the aid of microalloying, as well as the modification of pig iron and steel casting by the addition of rare-earth and rare elements merit attention. The changeover to the production of more diverse forms of rolled metals, roll-formed and combined sections in metallurgical production, thermal hardening of the surface layer of rolled parts and its saturation with additives that improve the physicomechanical properties--all this increases the reliability and durability of items and thereby serves as one more source of the saving of metals.

Substantial progress is nneded in the technology of applying protective coatings to metal products, which prevents its destructive attack by corrosion. What are meant here are coatings, which are accomplished by electroplating, and paint and varnish coatings, the protection of surfaces with the aid of polymer materials, petroleum bitumen, synthetic rubbers, and

latexes, and the chemical treatment of surfaces (phosphating). The scale on which these technologies are applied and in particular the quality of coatings clearly do not satisfy the requirements of ensuring the integrity of metals and metalware. As a result, annual losses of metal in the national economy due to corrosion comprise one-sixth of total metal output. The value of the damage from the removal of machinery and structures from operation for this reason is many times greater than the necessary expenditures on the introduction of corrosion control agents.

There are substantial reserves for introducing advanced technologies in the construction materials industry and in construction. Here such directions of resource saving as the dry method of cement production, the use of precast reinforced concrete as the principal construction material and the industrialization of construction from prefabricated reinforced concrete modules, the increase of the amounts of prefabrication of complete buildings and structures based on lightweight metal and other effective components and materials, and the broader use of cellular concrete, asbestos cement, gypsum, and other lightweight construction materials are promising.

A considerable role in resource conservation belongs to so-called integrated [skvoznyye] technologies and technological processes that permit the total processing of the primary material and that bring it as close as possible to the useful final article, preventing the formation of unutilized intermediate products that form production waste. Modern technological progress provides production with methods for making full use of material through the successive transformation and production of products usable for various spheres of consumption. Thus, the prolongation of the technological process of the logging and processing of timber and its extension to the processing of the "waste" that goes unutilized during logging make it possible to commit to the economic turnover free raw materials for the production of fiber and particle board, plywood, cardboard, paper, chemical products, feed additives, and biomass.

At the same time, the possibility of using by-product materials and waste is being poorly utilized in t construction materials industry where only 5 percent of the total unutilized product is used. In the cement industry, approximately 400 million tons of overburden and by-product rock annually end up as tailings. Enterprises in the nonmetalliferous industry discard many million tons of limestone which is suitable for the production of lime that is needed in agriculture. Progress is slow in the utilization of ashes and coal waste as a raw material for the production of ceramic walling.

The use of integrated technologies is impeded by the narrow departmental approach, when each sector is interested only its own output and considers by-products and other residual materials as an "alien" matter which is not characterist of it. In this regard, THE INTRODUCTION OF INTEGRATED INTERSECTORIAL TECHNOLOGIES FOR THE COMPREHENSIVE PROCESSING OF RAW MATERIALS AND MATERIALS, which ensure their full utilization in the national economy, SHOULD BE SINGLED OUT AS A SPECIAL OBJECT OF THE PLANNING AND MANAGEMENT OF TECHNICAL AND TECHNOLOGICAL PROGRESS. Such technologies should be developed and applied under the direction of interbranch scientific technical complexes,

organs for managing multisectorial national economic complexes, the USSR State Committee for Science and Technology, and USSR Gosplan.

The task of the technological support of the use of secondary resources in the form of slag, ash, shavings, industrial and household waste is directly related to the problem of intersectorial technologies. Total waste per person in the industrially developed countries is approximately 5 tons a year, of which approximately 10 percent is household waste. Most waste is processable and should be regarded as secondary resources. This makes it possible to increase their share in the raw materials balance several fold. The technology for recycling and transforming them into material resources or even into final products has already been created and hence there is every basis for speaking of the birth of a new technological branch--the methods of processing secondary materials.

It is important to launch immediately in the sectors of the national economy scientific research and planning, design and technological development on the devising of equipment and the assimilation of such technologies. Planning agencies should include research in the assignments of plans and scientific and technical programs on the assimilation of new equipment and the introduction of advanced technological processes.

The development and broad use of effective technologies for utilizing secondary products are a significant source for augmenting the national economy's material fund. As shown by the experience of the GDR, in the course of carrying out the state plan for 1981-85, over 10 percent of the total requirement for basic raw materials was satisfied by the utilization of secondary resources. Their share in the production of steel is 75 percent; copper--approximately 70; paper and cardboard--50 percent. The first installations for the total processing of household waste, which make it possible to use purposefully up to 90 percent of its amount, have been put into operation in industry.

Special-purpose technological complexes for the biothermal conversion of household waste into biofuel and compost have been created in Leningrad. Since 1982 the country's first plant for the pyrolysis of uncompostable waste with the obtaining of pyrocarbon--an effective graphite substitute--has been operating in the city. The Leningrad experience, which merits wide dissemination, attests to the great potential for intensifying the utilization of "throwaway" material resources.

In addition to the rapid assimilation and introduction of materials-saving technologies, more attention must be devoted to fuel- and energy-saving technological processes. Here there are also broad opportunities for satisfying the national economy's needs for fuel and energy under the conditions of a slight decrease of the growth rate of extraction of the basic types of fuel- and energy-producing raw materials.

The technology of drilling wells, of extracting oil from beds, of performing stripping and tunneling operations in coal mining, and of the high-pressure pumping of gas needs further improvement. Intensive technologies for performing these operations are the means of maintaining and increasing fuel

production. Production lines for extracting fuel from the ashes of thermal electric power plants and coal concentration waste, for synthesizing fuel from household waste, for producing nonconventional types of hydrocarbon fuel from common, inexpensive organic components can make an important contribution to the national economy's fuel balance.

Energy conservation also depends on scientific and technical progress in energy technology, that is, on methods of converting fuel into energy and one form of energy into another, and on methods for transmitting energy over long distances. The application of effective energy carriers, power-generating units with high unit capacity, reliable thermal protection, economical electric power transmission lines and transformer substations--all this will save energy. In addition to the rationalization of the processes of generating and transmitting power, it is essential to carry out research on increasing the economy of the technologies of energy consumption, bearing in mind the decrease of the power-output ratio and energy losses in machines, units and household appliances.

In the interests of the long-term future the efforts of scientists should be focused on the development of fundamentally new technologies and techniques of producing and processing new materials which have special properties. The work in this direction with allowance made for its difficulty and large outlays can be significantly accelerated by coordinating the efforts of CEMA member countries. Such coordination is envisaged by the comprehensive program of scientific and technical progress of the CEMA member countries to the year 2000. Joint measures on the development and assimilation of new and the improvement of existing technologies for the production of items with the minimum consumption of power, raw materials and materials and for the creation of special production equipment to this end take up much space in it. The implementation of the comprehensive program makes it possible to raise the level and expand the scale of application of energy-saving, low-waste and waste-free technologies.

The development of technological specialization of enterprises, associations, shops, and sections in sectors of the national economy, especially in machine building, is a key condition to the intensification of social production. In addition to part-assembly specialization, it serves as the prerequisite to the acceleration of scientific and technical progress and to the expansion of the scale of introduction of highly effective machining methods. Such specialization, which is manifested in the specialization of production units in certain types and modes of machining, permits the more effective use of equipment and the speedier introduction of advanced technologies, eccompassing by it vast areas of production. Small technologically specialized enterprises can produce considerable volumes of products, semifabricated goods and blanks. They are highly mobile, capable of accumulating technological innovations and of being changed over with allowance made for the latest advances in science and technology.

The extensive possibilities of increasing production efficiency and saving resources, which concentration and technological specialization afford, are the present are being used extremely poorly; the level of specialization is low. The widespread "erosion" of technological specialization and the attempt

to combine heterogeneous types of production at the same enterprise do not make it possible to concentrate efforts on raising the level of leading technological processes which encompass considerable amounts of processing. Under these conditions, there is an urgent need for the standardization of technological decisions in the designing of enterprises, for the broad introduction of standard complexes and and systems of equipment for technological processes, and for the increase of the level of specialization of production units.

Equally important is the problem of large-scale introduction of universal sectorial and intersectorial technologies. What is meant is not individual technological processes with a narrow area of application in the production of one type of product or at one enterprise (several enterprises), but technologies that are used for many types of products, at many enterprises and in a number of sectors.

The rapid replacement of obsolete technologies by new technologies depends in large measure on planning. A special subsection "Introduction of Advanced Technology, Mechanization and Automation of Production Processes" is singled out in the section "Development of Science and Technology" of the five- and one-year state plans of USSR economic and social development. It includes assignments on the assimilation of the most important types of advanced technologies, production equipment and means of mechanization and automation, which are being used in the country for the first time, and assignments on replacing backward production processes with advanced processes that play a leading role in series and mass production or that influence the technical and technological level of sectors and subsectors. Every assignment included in the draft plan is substantiated by indicators which are generalized in charts of the technical level of measures on the technical improvement of production.

The introduction of advanced base technologies finds its expression in the planning of basic indicators of the technical level of production and the most important types of output.

At the same time, the practice of exerting a planned influence on technological progress has far from exhausted its potential. At the national economic level, the introduction of a universal type of intersectorial technologies should become the basic object of planning. As to technological processes for the sector and individual associations and enterprises, it is necessary to provide for them in the plans of ministries, departments, and the basic link. The state plan will thereby be freed of functions not characteristic of it.

It is important to increase the technological orientation of national scientific and technical programs that are approved as part of five-year plans for economic and social development. Economically and technically substantiated measures on increasing the technological level of production should become an integral part of plans of the retooling and renovation of operating works.

It is advisable to change the structure of indicators of the planning of technological progress. What is meant is the more complete reflection of

indicators, which characterize the scale of dissemination of new technology, its influence on the reduction of the labor-, materials- and power-output ratio, and the increase of product quality.

The the certification of technology, which is being introduced everywhere, is called upon to become an effective means of increasing the technological level of production. The strenghtening of the orientation of the system of economic stimuli and levers toward increasing the material interest of all participants in production in the large-scale introduction of advanced technologies can play no little role in th- acceleration of technological progress. Indicators of the technological le   of production should be included in the group of indicators of the evalu   of economic operations, which influence the formation and use of stim... funds.

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5013
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IMPROVEMENT OF KAZAKH ENTERPRISE PASSPORT SYSTEM

Alma-Ata NARODNOYE KHOZYAYSTVO KAZAKHSTANA in Russian No 8, Aug 8 pp 19-22

[Article by S. Bayzakov, director of the Scientific Research Institute of Automated Planning and Management Systems attached to the Kazakh SSR State Planning Committee, and K. Rakhimov, chief of the Department of Automation of Data Processing: "The Enterprise Passport: Status, Prospects, Problems"]

[Text] The questions of the improvement of planning and the increase of the role of the state plan as the principal tool of the implementation of our party's economic policy occupy an important place in the improvement of the economic mechanism. A number of measures on raising the level of planning in all links of the economy and concentrating forces and resources on the fulfillment of programs, which promote the growth of labor productivity and the maximum utilization of production capacities and fixed capital, have been outlined.

The compilation of a passport for every production association (enterprise) and its subsequent revision are among the important factors that make it possible to make a detailed economic analysis, to identify the reserves for accelerating the growth of and increasing the efficiency of production, and to create the necessary conditions for the elaboration of intensive plans and for the organization of the proper monitoring of their fulfillment.

The statute on the passport on the production association (enterprise) states: "The passport of the production association (enterprise) is intended for the drawing up and economic substantiation of the drafts of five- and one-year plans of economic and social development and serves as the basis for selecting the most rational ways of increasing production efficiency, for finding reserves for additional output while formulating counterplans, and for analyzing the utilization of production capacities."

The passport's data make it possible to calculate assignments on the dynamics of production for a broader products list based on the needs of the national economy and the population; indicators of the final results of the activity of associations (enterprises), sectors, and ministries, as well as the plan on the mechanization and automation of production; the growth of labor productivity; indicators of production efficiency; to ensure the balance of

the plans of production and resource supply and the coordination of territorial and sectorial plans of economic and social development.

On the basis of the statute on the passport, the republic Gosplan drafted and approved the form of the passport of the production association (enterprise), of ministries and departments of republic subordination, and the Scientific Research Institute of Automated Planning and Management Systems [NII ASPU] attached to KazSSR Gosplan has been charged to ensure the automated input and storage of the passports' data and the processing and issuing to the sectorial departments of Gosplan and other interested organizations of the necessary indicators on their request within the deadlines set by them.

Gosplan's sectorial departments in turn are charged to ensure the receipt of passports from associations (enterprises) in their charge, the checking of the completeness and quality of their compilation, verify them for complete and proper compilation, and their annual (by 1 March) submitting to the NII ASPU for storage and processing.

The automation of the processing of the passports' data was commenced in parallel with the compilation of the forms. Lists of top-priority tasks and albums of output forms were elaborated and approved together with sectorial departments of Kazakh SSR Gosplan.

The NII ASPU of KazSSR Gosplan has gained some experience in this direction. Thus, on the basis of the requests of the sectorial departments of Gosplan for enterprises of local industry, light industry, the meat and dairy industry, geology, nonferrous and ferrous metallurgy calculations were made for the following set of tasks, by which there are determined: output volumes in physical and value terms; the effectiveness of the utilization of fixed production capital; indicators of capital construction; the growth rate and level of labor productivity; the limit of the number of works, the wage fund, and the assignments on curtailing the use of manual labor; profit from principal activity and miscellaneous sales and its distribution on the basis of the established norms, including payments to the budget; indicators of nature conservation, the efficient use of natural resources, and others.

In accordance with requests of the departments for housing and municipal services, the chemical and fuel industry, power and electrification, and the machine building industry of KazSSR Gosplan calculations were made regarding the formulation of the basic indicators of associations (enterprises) and the level of fulfillment of plan indicators by years of the 11th Five-Year Plan with allowance made for their growth rates; regarding the determination of production capacities and their utilization as well as the utilization of equipment.

In a practical sense, such information is useful by virtue of the fact that the dynamics and growth rates for a number of years are cited with respect to the basic technical and economic indicators characterizing the activity of associations (enterprises), groups are made with respect to production factors and economic attributes, deviations of the plan indicators are determined, and a summary by indicators and enterprises with a breakdown by sectors and

territory is cited. All this decisively facilitates the analytical work of Gosplan specialists.

The compilation of passports of enterprises of union subordination, which belong to nonferrous and ferrous metallurgy and the chemical, fuel and machine building industry, has been completed. Thus, at the request of directive organs, calculations are made on the basis of passport data for the following sets of problems: the formulation of the basic indicators of associations (enterprises) for the analysis of economic activity; the evaluation and analysis of the final results of the activity of an association (enterprise), and the intensiveness and level of fulfillment of plan indicators by years of the five-year plan.

The activity of the production associations of republic energy systems during 4 years of the 11th Five-Year Plan was analyzed as an experiment. These materials together with conclusions and proposals were transferred to the sectorial department of Kazakh SSR Gosplan.

The republic's directive organs received the results of the analysis of the output-capital ratio for associations and enterprises. The area of application of information amassed and processed on the basis of passport data is very broad. Thus, during the 11th Five-Year Plan it was used at the predraft stage of compilation of the State Plan of the Economic and Social Development of the Republic, in the process of monitoring the course of fulfillment of five- and one-year plans, as well as in the form of reference and analytical information and the evaluation of the final results of associations (enterprises), the intensiveness and the level of fulfillment of plan indicators by years of the five-year plan.

Notwithstanding individual positive results and the practical significance of passportization, it cannot be said for the present that all possibilities for carrying out analytical and economic work on the basis of passport data are being fully utilized. First of all, not all ministries and departments of republic subordination and associations (enterprises) of union subordination submit passports according to the approved list. Every year the sectorial departments of the republic Gosplan turn over an average of 55 percent of the passports to the NII ASPU.

Work on the compilation of passports is poorly organized in the republic Ministry of the Construction Materials Industry (20 percent), Ministry of Construction of Heavy Industry Enterprises (45 percent), Ministry of Motor Transport (15 percent), Ministry of Highways (10 percent), and the USSR Ministry of Land Reclamation and Water Resources (40 percent). While they were not received at all from enterprises in the fruit and vegetable industry.

Some passports are completed with a poor quality, the forms are filled out inaccurately and incompletely: the installed capacity and its utilization; the labor-intensiveness of expenditures per unit of output; qualitative characteristics of fixed capital and output; the consumption of material resources; the rates of consumption and their average lowering. These shortcomings are especially characteristic of passports of enterprises in republic local and light industry.

In order to code the particulars of the standard sectorial forms of passports, associations (enterprises) should have a set of all-union classifiers. The descriptions of products, material resources, equipment, and so forth, which are cited in the passport, should ensure complete conformity to the descriptions used in the all-union classifiers. However, not everyone knows how to make proper use of classifiers and some do not even have them.

In the process of compiling and completing passports, abbreviations and incomplete names of products occur, and different types of products are combined into the same group. In some instances, only the brand of the equipment is indicated.

Of course, the coding of products, equipment and material resources is very labor-consuming work and requires a certain amount of experience. However, the incorrect entry of these items in the passport complicates still further the coding process when preparing for the storage of passport data in the computer.

Consequently, it is first of all necessary to supply all associations (enterprises) located within the republic with all-union classifiers with the further transfer of passport coding functions to them. To date, as a result of the incomplete and low-quality filling out of passports difficulties are being created for their complete storage and the comprehensive analysis of all the basic indicators with a breakdown by sectors, ministries, departments, oblasts, and the republic as a whole and the level of reliability of the information itself is decreasing.

Since the compilation of passports of production associations (enterprises) was begun during the 11th Five-Year Plan, the need has arisen to develop and implement an automated system of the maintenance and processing of passport data (ASOP). There is no doubt as to the urgency of this question. Territorial planning agencies will have full and exhaustive information on the activity of enterprises within the sphere of their work and will consequently be better able to ensure the balance of planning calculations with a breakdown by territory and sector.

On the other hand, the growing volume of incoming information and the need to process it demand the automation of this process and the solution of preplanning tasks in planning and management with the use of passport data.

What is more, in the course of scientific research work, the need arose to use this information to evaluate the end results of the activity of associations (enterprises), the sector, and ministries.

Proceeding from the existing conditions of the development and introduction of computer technology in the republic and the interaction of ministries and departments within the framework of the republic automated management system and the automated system of planning calculations, it is proposed to develop the ASOP in several stages.

Work has now begun on the implementation of the first stage. In all 13 sets of information-reference and analytical problems, which include the solution of 85 problems, have been compiled and introduced. Calculations are carried out systematically, with a cumulative result by years of the five-year plan, with any breakdown: by ministry, oblast, sector, association (enterprise).

The sets of problems may be used in the practice of economic analysis and planning at all levels of management of the republic's national economy and in local planning organs. They have tested software and programs, are easily understood by any planner and manager, and are ready for use in the ASU's of local planning organs.

On the whole, at the first stage of development of the ASOP, in addition to the indicated sets of problems, a number of organizational questions were also resolved, including: the questions of informational and technical interaction of system subscribers on the basis of unified passport forms and their transfer were elaborated; specialists were trained to fulfill functions associated with the operation of the ASOP; dictionaries and classifiers necessary for the functioning of ASOP were devised; the issuing of the processed information (on priority problems) to the republic's directive organs was ensured.

At the second stage of development and introduction of the ASOP it is planned to accomplish the following tasks which are of no less practical importance:

--the collection, monitoring and storage of passport data for all republic industrial facilities, which are received in the form of documents, but will subsequently be received on magnetic media;

--the completion of the introduction of the centralized information bank of passport data;

--the introduction of a system for the classification and coding of passport data;

--procedural supervision and the resolution of organizational questions;

--the development of information means and programs, which ensure the effective retrieval, processing and issuing of any information to republic directive and planning organs;

--evaluation of the end results of the activity of associations (enterprises), sectors, ministries, and departments with subsequent proposals on increasing production efficiency;

--the making of an economic analysis of the activity of associations (enterprises) and the sector with the use of mathematical economic and statistical methods;

--the storage of dynamic series of indicators of republic associations (enterprises) for the purpose of ascertaining the growth of their production activity and determining the forecast indicators for the future;

—the further improvement of the passport's structure, forms and indicators in the light of the demands of the republic's directive and planning organs.

A number of sets of problems within the framework of the ASOP are scheduled to be used in the work of local planning organs. Under the conditions of the functioning of the territorial organs of management within the framework of ASU's they should have complete information which thoroughly characterizes the basic parameters of existing and newly commissioned facilities. Up until now, such data have not been systematically gathered and accordingly have not been recorded in either primary or summary documents of statistical reporting.

The accomplishment of such tasks requires the creation of an information bank of the data, which characterizes with a rational degree of detail the present state and potential of individual economic entities. Thus, it a question of the creation of separate information files, which reflect the resource and economic status of regions and are based on the automated system of the maintenance and processing passport data.

The latter, in turn, will serve as the information-reference basis for compiling the plan of economic and social development of the oblast and individual regions of the republic and will ensure the systematization of technical and economic information with the use of sophisticated computers.

In this regard, workers, who were dealing with the automated passport processing system, were given a number of practical problems, with which it is possible to group: the accumulation of dynamic series of technical and economic indicators of the republic's associations (enterprises) for drawing up and substantiating drafts of five- and one-year plans; the analysis and search for reserves for increasing the efficiency of social production with the subsequent submission of proposals to the organs which make management decisiona; the solution of the problems of the development, location, and specialization of the production of individual sectors of industry; the making of multivariate optimization planning calculations with the use of mathematical economic and statistical methods and developed planning and management models.

The information support of the ASOP should be carried out by the horizontal and vertical processing of information and with varying degrees of its generalization on the basis of a unified set of indicators, unified classification and coding and a unified system of documentation. This problem has not been fully solved as yet by specialists of the NII ASPU. The set of models, methods, algorithms, programs and means of programming, which ensure the elaboration of optimization problems, has not found broad application in the solution of practical problems.

In the near future it is necessary to ensure the realization of a man-machine dialog, the automation of the collection of information, its accumulation and and the reliability of storage on computer media, the monitoring of completeness and preservation, and the logical monitoring of the information being put it, stored, and issued.

The study of the practice of elaborating and using passports in various sectors of industry (UkSSR Ministry of Local Industry; the Ministry of Light Industry and the Ministry of Instrument Making, Automation Equipment and Control Systems in the Lithuanian, Latvian, Azerbaijan and Estonian republics) has shown that despite some positive examples, the existing variant of the passport requires the refinement of individual sections of it for the purpose of using them as the basis of economic and engineering calculations and baseline materials of five- and one-year plans.

The structure and composition of information included in the passport require further improvement because it is as yet compiled not as a preplanning document, but as a summary of statistical and accounting reporting data of work. In the existing passport, for example, provision is not made for a database for making proposals on the broad introduction of a system of progressive technical and economic norms and standards and on the improvement of their relationship with final national economic results.

We believe that the unified scientific methods supervision of both the elaboration of passports and the use of their data at various levels of management is also being implemented inadequately. A main organization that would carry out the unified scientific methods supervision of these matters has not been appointed at the national level.

In our view, it is necessary to:

—designate a main organization which is responsible for the elaboration of passports and procedural instructions on their use;

--prepare sectorial procedural instructions on the elaboration, filling out, and utilization of passport data at various levels of planning and management with allowance made for sectorial peculiarities;

--specify that economic planning departments (administrations) and the Gosplans of union republics engage in the supervision and organization of work on the elaboration and application of the passport;

—improve the structure and forms and define more precisely the composition of indicators of the passport of associations (enterprises), ministries and departments, which are subordinate to the Kazakh SSR Council of Ministers;

--bring the all-union classifiers up to the level of associations and enterprises and introduce them with the timely incorporation of amendments and addenda in the classifiers;

—compile passports in five copies. No 1 (the control copy) should be kept permanently at the enterprise; No 2 should be conveyed to the oblast (city) planning commission which should in turn convey it to the NII ASPU; No 3 should be sent to the main organization for in the processing of the passport data of sectors (ministries, departments); No 4 and No 5 (exchange fund) should be left at the enterprise for the annual exchange of passports.

I would once again like to call the attention of managers of production associations (enterprises) and planners to the need to improve the quality of work on the preparation, filling out and timely submission of passport data, regarding it as a most important basis of the improvement of the compilation of the economic substantiation of draft plans and the selection of rational ways of increasing production efficiency.

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NEW POSSIBILITIES FOR CUTTING LEAD TIME EXPLORED

Moscow NTR: PROBLEMY I RESHENIYA in Russian No 20, 21 Oct-3 Nov 86 pp 4-5

[Interview with V.V. Simakov, member of the Collegium and chief of the Science and Technology Consolidated Department of USSR Gosplan and deputy chairman of the Problem Commission of the USSR Academy of Sciences and the State Committee for Science and Technology "Discoveries, Inventions and Patent and License Work in the USSR" of the Comprehensive Program of Scientific and Technical Progress in the USSR for 1991-2010, by An. Shakhov: "The Planned Succession of Generations of Equipment. New Possibilities of Shortening the Cycle 'From the Idea to the Machine'"; date and place not specified; first paragraph is NTR: PROBLEMY I RESHENIYA introduction]

[Text] "In the course of rapid scientific and technical progress," M.S. Gorbachev emphasized in his address at the All-Union Conference of Social Science Chair Heads, "the intellectual, scientific potential is becoming society's most important resource, which by its nature is inexhaustable. And the solution of the historical tasks of acceleration depends in large measure on the thrifty, effective use of this potential." V.V. Simakov, member of the Collegium and chief of the Science and Technology Consolidated Department of USSR Gosplan and deputy chief of the Problem Commission of the USSR Academy of Sciences and the State Committee for Science and Technology "Discoveries, Inventions and Patent and License Work in the USSR" of the Comprehensive Program of Scientific and Technical Progress in the USSR for 1991-2010, tells how such an approach is being implemented.

"Already during the 12th Five-Year Plan," V.I. Simakov states, "the nation's scientific and technical potential is undergoing leading developing: it is planned to increase substantially the allocations for science for the countries as a who and to increase them to 33 billion rubles, their growth rate will exceed the growth rate of the national income by 1.5-fold, and capital investments will grow by 70 percent. Nevertheless, the present state of the qualitative aspect of growth is a source of justifiable concern."

[Question] In what directions, in your opinion, is it now necessary to stimulate the creative activity of scientists, production organizers, and engineers?

[Answer] That is the main question. The acceleration of scientific and technical progress is impossible without the planned concentration of intellectual and national economic resources in the priority directions.

I shall name five of these directions: total automation; electronization of the national economy; atomic energy; new materials and the technology of their production and processing; and biotechnology. They are envisaged by the Comprehensive Program of Scientific and Technical Progress of the CEMA Member Countries to the Year 2000.

The acceleration of the country's socioeconomic development requires the sharp reduction of the share of manual labor, this problem is particularly acute in the fuel and energy branches. Here the share of manual labor is as high as 32 percent, having encompassed about 700,000 persons. The release of these people and their employment in more highly skilled work constitute an impressive socioeconomic reserve of our society. The reduction of manual labor is effective in two ways: it narrows the zone of exhausting and unproductive labor, while increasing product quality.

Closely related to this task is another one--the automation of assembly and installation, monitoring and measuring, and testing operations.

An analysis showed that in the machine building branches from 19 to 32 percent of the manpower resources were spent on the performance of these operations during the last five-year plan and this share has grown each year.

It is clear that here, too, total automation and electronization, in addition to a direct socioeconomic effect, will have a fundamental impact on the enhancement of such a key property of a product as reliability. And this in turn entails the elimination of many channels of economic losses and a sharp reduction in the volume of repair work. The latter still diverts more than 4 percent of the highly qualified personnel, a considerable machine tool inventory, and a significant amount of materials.

Serious efforts are also needed in such an important direction as the creation of fundamentally new energy- and resource-saving technologies that ensure ecological safety.

[Question] However, everything you have discussed up to now substantially raises the role of the economic mechanism within which innovations are realized. How will economic levers and stimuli influence the acceleration of scientific and technical progress?

[Answer] The essence of the present method of economic management consists not only in the making of optimal technical decisions, but also in the ability to stimulate personnel, to foster a creative working environment in the labor collectives, to actively introduce new forms of the organization and remuneration of labor.

Up to now the planning and financing of scientific organizations and production enterprises have been carried out by various superior organizations and from various sources. The results of the work of NII's [scientific

research institutes] and KB's [design bureaus] are evaluated on the basis of the plans of research and development, while those of production enterprises are evaluated on the basis of the results of production activity. This procedure hinders the concentration of resources and the direct stimulation of work on the accelerated development of new highly effective products.

The management techniques developed in branches make it possible to link the system of economic levers and stimuli more and more closely with the end results of the development and application of new equipment. The forms of stimulation are being improved, incentive funds and the pricing mechanism are being diversified in the form of a system of wholesale prices, markups and discounts. Associations and enterprises are thereby encouraged to accelerate the updating of products and to take obsolete products out of production.

However, these measures now are also not sufficient for the radical improvement of the indicators of production efficiency.

From the beginning of next year, fundamentally new cost accounting methods of economic-planning management will be introduced at hundreds of enterprises and associations of a number of ministries. They will also arouse the creative interests of developers, producers and consumers, while at the same time increasing their responsibility for the end result. The ministries, which are changing over to full cost accounting and self-financing, have been granted the right to convert the scientific, design and technological organizations, which belong to scientific production associations and production associations, to these conditions.

The appropriate departments of USSR Gosplan and the State Committee for Science and Technology are drafting proposals that make it possible to give the status of commodity output to the results of scientific and technical activity. Development will for the most part be performed on the basis of contracts with enterprises, organizations and client ministries. Here loan capital will begin to be used more actively instead of nonreturnable financing from the unified fund for the development of science and technology.

Now only the price agreed upon by the client will become an integrated indicator of the quality and scientific and technical level of the product and the degree of their satisfaction of world and long-range demands.

At the first stage innumerable branch and similar exhibitions of achievements can become the place for ascertaining the use value of new machinery.

A few words about financing practice. A tradition has formed, in case of which funds for the development of science and technology are allocated to a certain organization. This checks progress and aggravates the defects of departmentalism to a considerable degree. What is more, in the given organization there might also not be a group of specialists competent to solve an urgent complex problem. Such an organization may be hampered by departmental preferences and stereotypes of limited scientific and engineering concepts. The transition to cost accounting relations affords the opportunity to finance not the organization, but the solution of important technical and

economic problems. This will also eliminate many established shortcomings and difficulties.

[Question] In one of his speeches M.S. Gorbachev emphasized: "Revolutionary changes--the transition to fundamentally new technological systems, to equipment of the latest generations, which provide the greatest efficiency--are needed." What is being done in this direction?

[Answer] The solution of this problem required new methods of formulating the goals and principles of planning. They are being developed and tested in the close contact of USSR Gosplan with the State Committee for Science and Technology, the USSR Academy of Sciences, the USSR State Committee for Standards, ministries and departments.

A qualitative model of the development of equipment has been developed for this purpose on the basis of domestic scientific developments that have been tested in a number of branches. The cardinal improvement of the quality of equipment on the basis of the use of computer hardware and systems was made the basis for it. The model is built in accordance with the gradation of generations of equipment, which has been adopted in world practice (see the table). The integral technical and economic basis for classifying a design with a new generation of equipment is its ability to ensure a sharp increase in the productivity of social labor.

During this development an analysis and forecast of the cyclical nature of the corresponding generations of equipment in the world economic system were also made (see the graph).

The model of generations of equipment makes it possible to make a consolidated qualitative evaluation of the scientific and technical level of products at various stages of their life cycle--in the performance of basic and exploratory research, in the process of research and development, as well as in the drafting of proposals for reconstruction and for the creation of new capacities for series production.

The comparison of variants of reconstruction of an ore dressing combine, which was made in USSR Gosplan departments on the basis of the analysis of the efficiency of existing equipment (variant 0), the utilization of equipment of a greater unit power (variant 1) and new-generation equipment (variant 2), can serve as an example of such a consolidated evaluation.

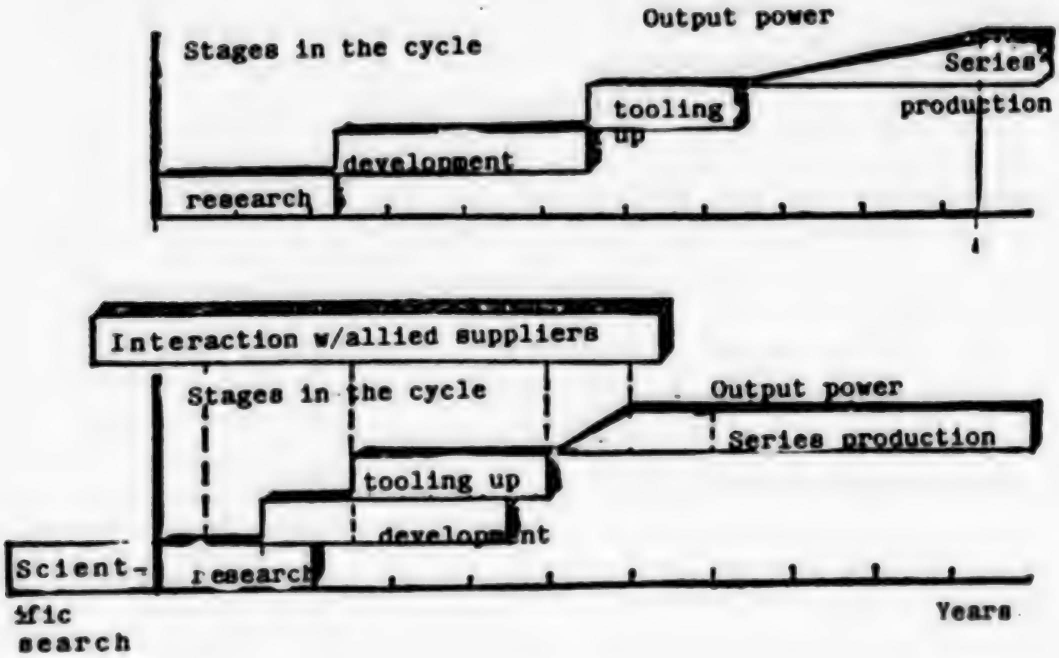
Comparative analysis of variants shows that only new-generation equipment (variant 2) affords the possibility for an almost sevenfold reduction of units of equipment (compared with variant 0), a more than fourfold reduction in the area of construction, an approximate fivefold reduction in construction volume, a reduction in the estimated cost by one-third, and that the annual labor productivity per worker can be increased by fivefold.

Summarizing such research, it can be asserted that it is necessary to purposefully remove second and third generation equipment from production because it is in principle incapable of satisfying the present technical and economic requirements.

Qualitative Model of Generations of Equipment

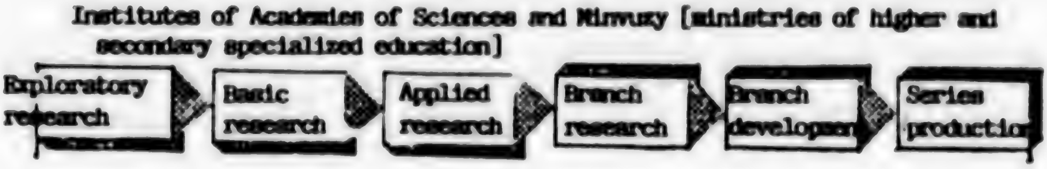
<table>
<tr><th rowspan="2" colspan="2">Qualitative features</th><th colspan="5">Generation of equipment</th></tr>
<tr><th>Second</th><th>Third</th><th>Fourth</th><th>Fifth</th><th>Sixth</th></tr>
<tr><td rowspan="10">Functional</td><td rowspan="5">Level of automation of control in systems</td><td></td><td></td><td></td><td></td><td>Teaching systems w/artistic, intellectual features</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Flexible programmable systems w/adaptation & internal diagnostics</td></tr>
<tr><td></td><td></td><td colspan="3">Totally automated systems w/adaptation to external influences</td></tr>
<tr><td></td><td colspan="4">Automated control systems</td></tr>
<tr><td colspan="5">Semiautomatic control</td></tr>
<tr><td rowspan="5">Level of of automation of control in apparatus</td><td></td><td></td><td></td><td></td><td>Automatic control w/elements of artificial intelligence</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Adaptive automated programmable control</td></tr>
<tr><td></td><td></td><td colspan="3">Automated control w/adaptation to external influences and self-diagnostics</td></tr>
<tr><td></td><td colspan="4">Automated control of individual devices</td></tr>
<tr><td colspan="5">Semiautomatic and manual control</td></tr>
<tr><td rowspan="12">Constructive</td><td rowspan="4">Computer technology</td><td></td><td></td><td></td><td colspan="2">Supercomputers, multisystem networks</td></tr>
<tr><td></td><td></td><td colspan="3">Microprocessors, microcomputers (programmable controllers), built-in local networks</td></tr>
<tr><td></td><td colspan="4">Minicomputers (peripheral), local networks</td></tr>
<tr><td colspan="5">Second generation computers (central), multiprocessor systems</td></tr>
<tr><td rowspan="3">Functional electronic devices (functional integration)</td><td></td><td></td><td></td><td></td><td>Bionic functional systems</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Multifunctional devices</td></tr>
<tr><td></td><td></td><td colspan="3">Functional devices</td></tr>
<tr><td rowspan="5">Electronic devices (degree of integration (el/cryst)</td><td></td><td></td><td></td><td></td><td>Integrated systems</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Integrated circuits (10^5-10^6)</td></tr>
<tr><td></td><td></td><td colspan="3">Integrated circuits (10^4)</td></tr>
<tr><td></td><td colspan="4">Integrated circuits (10^2-10^3)</td></tr>
<tr><td colspan="5">Discrete elements</td></tr>
<tr><td rowspan="10">Technological</td><td rowspan="5">Technology of creation of a programmed product</td><td></td><td></td><td></td><td></td><td>Teaching programming systems</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Programming systems in a single high-level language</td></tr>
<tr><td></td><td></td><td colspan="3">Automated programming technology with high-level languages</td></tr>
<tr><td></td><td colspan="4">Package programming with high-level languages</td></tr>
<tr><td colspan="5">Programming in machine codes and with algorithmic languages</td></tr>
<tr><td rowspan="5">Equipment & systems for the design, production and monitoring of products</td><td></td><td></td><td></td><td></td><td>Teaching design, production & monitoring systems</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Integrated design, production & monitoring systems</td></tr>
<tr><td></td><td></td><td colspan="3">Integrated automated design, production & monitoring systems</td></tr>
<tr><td></td><td colspan="4">Automated design, production and monitoring systems</td></tr>
<tr><td colspan="5">Equipment for automating individual design, production and monitoring operations</td></tr>
</table>

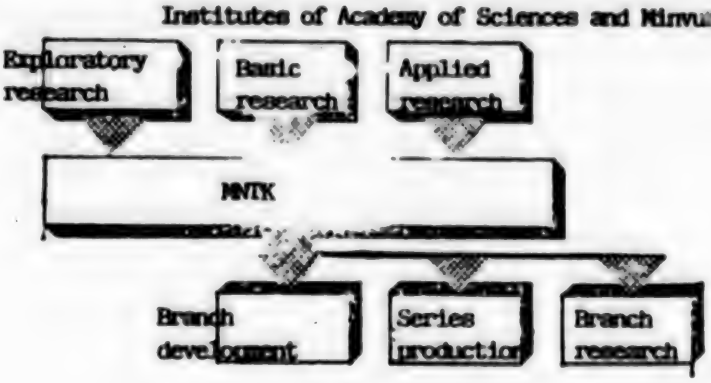
STRUCTURE OF THE LIFE CYCLE OF PRODUCTS



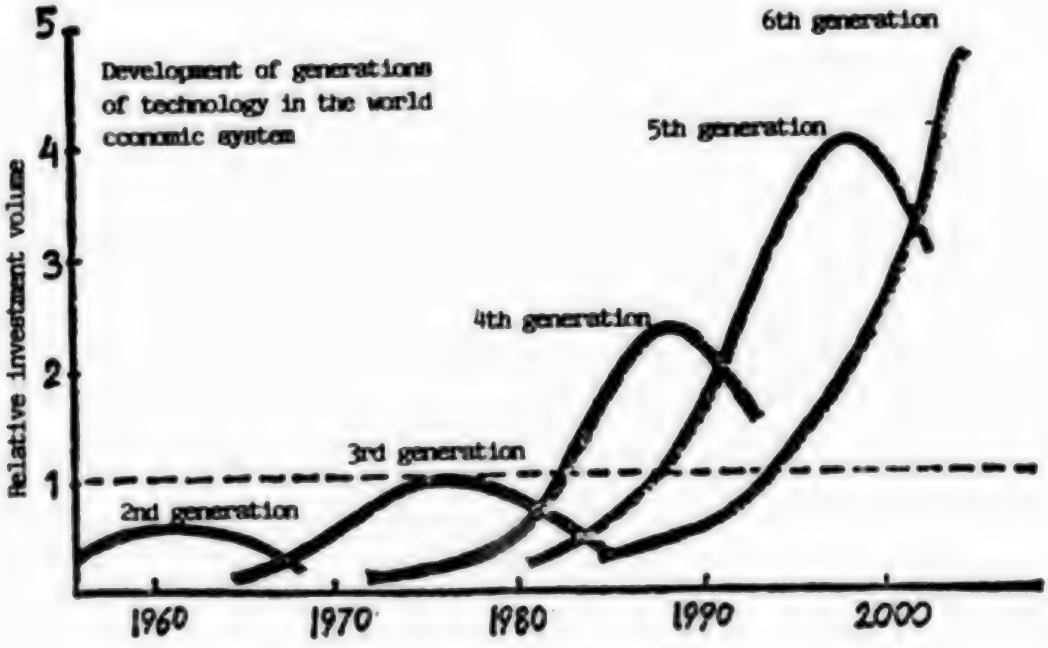
The inclusion of scientific search in the procedures of development [razrabotki], the transition from the sequential (above) to the "frontal" organization of it (below), and the combination of development [opytno-konstruktorskiye razrabotki] with the tooling up process--all this in its aggregate accelerates the creation of new equipment and the satisfaction of the needs for it.

STRUCTURE OF INTRODUCTION OF BASIC RESEARCH





The transition from sequential (above) and "frontal" (below) organization of development [razrabotki] reduces development from between one-third to one-half of the current level.



Planning and economic policy should consequently ensure the accelerated development of capacities for producing-fourth generation equipment and satisfying the need for it.

In turn scientific and technical programs, plans of research and development, and the reconstruction of pilot experimental bases should be "anticipatory" and be oriented toward the creation of systems of fifth-generation equipment.

It should be noted in particular that some basic research is already in progress in our country for the implementation of sixth-generation equipment. The time has come to concentrate intellectual resources for the comprehensive solution of scientific and technical problems of this level. There is a need to search for the most effective application of learning systems with features of artificial intelligence in the national economy.

It can be assumed that the plant of the 21 century, at which such advances will be realized, ia a large unified technological system, which includes computer-aided design systems and flexible production systems, which are permeated by a system of automatic quality control and quality assurance.

Experience shows that actual events always outstrip the boldest forecasts. The acceleration of scientific and technical progress is possible only if there is a high degree of preparedness of the scientific, technical, and production potential for intensive growth of the volume of work on new generations of equipment in "breakthrough areas."

[Question] Vladimir Viktorovich, when you addressed the first meeting of the Problem Commission (Footnote 1) (See NTR, No 19, 1986, p 2, "Manage Invention"), you emphasized that a few "breakthrough" inventions are worth hundreds of even the most original inventions that do not produce qualitative changes in the technological system. Cannot these hundreds become a foothold for a new breakthrough to a new technical quality?

[Answer] The question of raising responsibility for the correct determination of directions of development of science and technology and the timely exclusion of "pseudo-new" solutions is presently very urgent.

The fact of the matter is that an invention acquires social and economic worth only after it is transferred from the paper of the inventor's certificate and design documentation to the metal of new equipment. And this transfer entails the rapidly growing expenditure of increasingly scarce resources--time, manpower, material, and financial. Hence, the abundance of inventions, which are born of unguided creative initiative, is fraught with the dispersal of national economic resources and the intellectual and material "stripping" of the most promising directions of science and technology.

At the same time, we must always remember that in connection with the cyclicity of development of generations of equipment and the stable trend toward the shortening of the length of the life cycle, the rapid obsolescence of the qualitative attributes and characteristics of equipment occurs.

Therefore, a thrifty attitude toward intellectual potential requires of society the maximum concentration of resources on "scientific breakthrough areas."

[Question] Under the conditions of the acceleration of scientific and technical progress, what level of development is especially urgent for scientists, production organizers, engineers and inventors?

[Answer] Their creative work must be oriented toward basic revolutionary changes in social production. Toward the succession of new generations of not only equipment, but also technology, toward the changeover to fundamentally new types of them. To such ones which will increase efficiency no longer by percent, but by fold.

The peculiarity of generations of new equipment requires the development of whole technological systems. Here progress occurs not along the line of the usual replacement of one machine by another, but by the succession of an entire technological system by the next system, a system that is already based on a system of interconnected technologies, machines and materials of a new generation, which were developed on the basis of newly discovered principles.

Under such conditions, the creation of a single original machine, even a machine that makes use of a laser, for example, but that is incorporated in an old technological process, does not lead to serious end results. The same is true with the application of powerful, costly "machining centers" when producing parts of an old design, especially in a "fractured" technological process. Such equipment is unable to justify the expenditures on its development. You and I, unfortunately, have repeatedly witnessed such pictures of ineffective utilization of new equipment.

At the same time, there are very effective tasks of the continuous modernization of the established technological process and existing equipment within the period of its basic obsolescence.

Hence the problem of the well thought out orientation of the inventor's initiative at all levels of management (the enterprise, the branch and the national economy) arises. And accordingly the problem of increasing the responsibility of all levels of management for the effective utilization of the intellectual potential.

[Question] Obviously, such an approach to development will also require new organizational forms.

[Answer] Of course. The radical reform of the traditional sequential and stage-by-stage form of introduction of developments "academy institute-branch institute-design bureau-plant" will be needed.

In other words, the development of technological processes, systems of technological and monitoring-measuring equipment and even the production and the delivery to prospective users of test runs of items should be launched in parallel and simultaneously with basic and applied research.

As the experience of the leading collectives shows, here there arises the real possibility to speed up by nearly twofold the creation and development of new equipment and the training of personnel for its production and exploitation.

At the state level, the decision was made to create new organizational structures—interbranch scientific technical complexes (MNTK) and engineering centers, which are oriented precisely according to the "frontal" diagram toward the creation of new generations of equipment, technologies and materials, which correspond to or surpass the world level.

This year the first results have already been obtained at this very level: at the "Eye Microsurgery" MNTK and the "Institute of Electric Welding imeni Ye.O. Paton" MNTK, on the basis of respectively four and eight inventions that have been patented in scientifically and technically developed countries of the world.

The creation of scores of types of new generations of equipment, technologies and materials in accordance with developments of MNTK is envisaged with this aim in the draft of the "Development of Science and Technology Section" of the State Plan.

[Question] What are the new features that all this introduces into the planning of scientific and technical progress?

[Answer] The universal application of advances of scientific and technical progress in science, production, management and the social sphere. Such a planning system ensures both the formulation of plans based on advances of science and technology and the interconnection of plans with the economic mechanism at all levels--from labor collectives of enterprises, NII's and KB's—to ministries and complexes of branches of the national economy.

The system of comprehensive general indicators of scientific and technical progress will become the basic framework of the national economic plan at all levels of planning: the national economy in general, complexes of branches, ministries and enterprises.

Such structure of indicators makes it possible to combine the centralized formulation of assignments, which are oriented toward the necessary level of end national economic results, with the independence, initiative and responsibility of enterprises for the choice of the most effective means of attaining the established goals.

For the first time when drafting the plan of the 12 Five-Year Plan the assignments on the development of science and technology were oriented toward the creation and introduction of new generations of equipment, technology and materials.

Resource are concentrated, for example, on a several-fold increase in the production of rotary-conveyer lines and flexible production systems. This will make it possible to raise labor productivity by four- to tenfold, to reduce production area to between one-third and one-half of the previous level and to release thousands of workers. It is planned to expand by 1.5- to

2 fold the application of progressive baseline technologies and such fundamentally new technologies as electron-beam, plasma, biological, chemical, radiation, and other technologies. The potential of these technologies can be exemplified by radiation technology.

A group of scientists of the Siberian Department of the USSR Academy of Sciences has developed a technology based on the use of charged particle accelerators. The technology will now be actively incorporated in the chemical, petrochemical and other branches of the national economy. It intensifies many known processes. It reduces production costs, increases the productivity of machines, improves their operating properties and resistance to heat and wear, ensures the ecological cleanness of the production cycle, which eliminating toxic and highly flammable substances.

Radiation modification of polymer materials, while yielding products with improved physicochemical properties, saves between 15 and 40 percent of the primary raw material. Irradiation with an electron beam gives many conventional materials such valuable properties as resistance to cold and heat and higher strength. Technology makes it possible to create materials that remember shapes--for example, sealing rings which are easily installed when erecting the pipes of a gas pipeline, reliably sealing the joints.

New technology is already being applied in the production of heat-resistant cable in the Ministry of the Electrical Equipment Industry; heat-shrunk pipe and hoses in the Ministry of Construction of Petroleum and Gas Industry Enterprises; and artificial leathers--in the Ministry of Light Industry.

Gosplan, together with the State Committee for Inventions and Discoveries and other agencies, recently adopted a decision on the rapid development of this new-generation baseline technology. Calculations show that this can produce an economic effect in excess of 1 billion rubles during the current five-year plan. Such is the value of fundamentally new integrated technological developments.

[Question] You have already touched on the electronization of the national economy. Can you name if only a few development efforts of this type?

[Answer] Software now comprises between 30 and 70 percent of the cost of new generations of equipment. It has now become a most important intellectual product, in the production of which tens of thousands of specialists are already engaged today.

This product is evaluated by conventional indicators of quality, reliability and labor productivity. Because it cannot be directly materializable, it has generated problems associated with the creation of that product, with its storage and subsequent updating throughout its life cycle.

Soviet scientists have proposed and realized in automated lines a graphic programming technique that makes it possible to perform the most sophisticated programs in the form of sketches. Thus, the conventional technological stages in the creation of the programmed product--modeling, optimization and acceptance testing--now proceed with the use of our computer hardware. Then

it becomes part of the algorithm and program fund with the rights of a completed program.

The creation of this technology made it possible to increase the labor productivity of programmers by more than two- to threefold.

Technological systems in this class are also being developed within the framework of the "Electronization" program.

[Question] At the beginning of your speech at the meeting of the Problem Commission, you noted that contacts between the State Committee for Inventions and Discoveries, the State Committee for Science and Technology and USSR Gosplan have become stronger of late...

[Answer] I note that this is dictated by the very need for the acceleration of scientific and technical progress. The intellectual potential proves to be the basic resource for such contact. Each of the three committees bears its share of the responsibility for its proper orientation, for its economical, rational use. A circle of more and more effectively functioning persons of similar persuasion is forming in the process of solving this problem.

In conclusion I will emphasize: the concentration of the intellectual potential in the priority directions of technical progress is the key to raising the national economy's growth rates; this also ensures the increase of its pace and effectiveness.

5013
CSO: 1814/49

ALL-UNION PHYSICISTS' SEMINAR HELD

Dushanbe KOMMUNIST TADZHIKISTANA in Russian 14 Sep 86 p 2

[Article (TADZHIKTA): "All-Union Physicists' Seminar"]

[Text] Participants in the all-union seminar, which completed its work in Dushanbe, discussed urgent problems of the quality control of new composite materials. The materials in question are far superior to traditional materials in terms of their weight parameters and strength, the makers of both space equipment and household appliances need them.

The acoustic emission method, in case of which defects are detected in advance, with the determination of weak spots in items, is becoming the best tool for studying the possibilities of the organoplastics and various designs that are born in scientists' laboratories. In this case the material itself sends information about failure processes. To gather such information more thoroughly and to improve the quality of materials on its basis—the principal task of researchers consists in this. Many scientific centers in this country are participating in its accomplishment.

Not by chance was the forum held in Dushanbe. Work on acoustic emission has been successfully conducted at the Ultrasonic Physics Laboratory of the Physical Technical Institute imeni S. Umarov for more than 10 years now. The first automated acoustic emission unit for testing the strength of planar structures was developed at the special design and engineering bureau of the republic Academy of Sciences. Now another innovation—a system capable of evaluating three-dimensional structures--is next. The Tajik specialists shared their achievements with colleagues who had come from various cities.

At the seminar a program of the further development of acoustic emission methods of checking the quality of materials, their automation, and the use of these purposes both of physical and mathematical models and computers was outlined. All this should speed up the work of creating the latest composite materials—materials of the future.

The recommendations of the seminar contain the proposal to set up an acoustic emission section in the USSR Academy of Sciences.

13206
CSO: 1814/59

LOW TEMPERATURES PHYSICS CONFERENCE

Tbilisi ZARYA VOSTOKA in Russian 14 Sep 86 p 3

[Article: "Low Temperatures Are Being Studied"; first paragraph is ZARYA VOSTOKA introduction]

[Text] The All-Union Conference on Low-Temperature Physics has concluded its work in Tbilisi. Achievements in such fields of knowledge as electronic phenomena at low temperatures, quantum liquids and crystals, superconductivity...were discussed.

A GRUZINFORM correspondent asked Corresponding Member of the USSR Academy of Sciences, Aleksandr Andreyev, its supervisor and chairman of the Scientific Council of the USSR Academy of Sciences for the Problem "Low-Temperature Physics," to comment on the results of the conference.

"Soviet physicists—theoreticians and experimenters—are successfully solving an extremely complex scientific and technical problem: obtaining outer-space temperatures—minus 263 degrees Kelvin—under terrestrial conditions," said the scientist. "This was confirmed by the reports presented at the conference. We can state with confidence that Soviet science has management to achieve temperatures in the last few years a thousandfold lower than, say, in the preceding decade. Of what practical use is this?

"Superconductivity was discovered at the beginning of this century. This phenomenon was theoretically substantiated by American and Soviet scientists only in the 1960's. Today this phenomenon is helping to develop the creation of compact, light-weight superpower current generators, superpower electric power lines and electric motors. This is accomplished in conditions of extralow temperatures. Alloys and compounds, which were developed by the joint efforts of metallurgists, physicists, and chemists, are used as materials for the manufacture of these kinds of generators, motors, and electric power lines. Even a new field of technology has arisen—cryogenic electronics. This is high-precision and supersensitive instruments which are capable of measuring the strength of magnetic fields in the heart and brain. This is superconductive computers that approach the operation of the human brain in their capabilities...."

The successes in these fields of knowledge were also reported at the conference. The achievements of Georgian scientists in the field of low-temperature physics are great. The report they gave are the best evidence of that.

13206
CSO: 1814/59

INCENTIVES FOR INVENTORS, EFFICIENCY EXPERTS ANNOUNCED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 7 Oct 86 p 2

[Article: under the rubric "In the Ministries and Departments": "Incentives for Inventors and Efficiency Experts"]; first paragraph is SOTSIALISTICHESKAYA INDUSTRIYA introduction]

[Text] The USSR State Committee for Labor and Social Problems and the Secretariat of the All-Union Central Council of Trade Unions have adopted the decree "On the All-Union Socialist Competition of Inventors and Efficiency Experts for the Maximum Contribution to Accelerating Scientific and Technical Progress During the 12th Five-Year Plan."

The aim of the decree is to improve the moral and material stimulation of participants in the All-Union Socialist Competition of Inventors and Efficiency Experts and to increase their creative activity.

The USSR State Committee for Inventions and Discoveries and the Central Council of the All-Union Society of Inventors and Efficiency Experts have been authorized to establish 16 Challenge Red Banners with diplomas and monetary prizes for rewarding the winners of the competition.

These banners will be awarded to union and autonomous republics, krays, and oblasts which have fulfilled their obligations on the development of invention and efficiency promotion and have achieved the best results in mass technical creative work.

Whoever has more developed and introduced inventions and efficiency proposals and the greatest economic impact from their use will win the competition. Another condition is the fulfillment of the planning assignments on the growth of labor productivity, the increase of production quality, and the saving of all types of resources.

The USSR State Committee for Inventions and Discoveries and the Central Council of the All-Union Society of Inventors and Efficiency Experts have been charged to summarize the results of the competition and to reward the winners.

The decrees of the USSR State Committee for Labor and Social Problems and the Secretariat of the All-Union Central Council of Trade Unions of 12 April 1976 and 4 December 1981 are no longer in force.

13206
CSO: 1814/59

BRIEF

RAMAN SCATTERING SPECTROSCOPY CONFERENCE--(TADZHIKTA)--The desire to probe ever deeper into the secrets of matter is forcing scientists to search constantly for the most effective means of achieving their goal. Raman scattering spectroscopy--the researcher's all-purpose tool--has become one of such means. The all-union conference on Raman scattering spectroscopy, which recently concluded its work in Dushanbe, was devoted to the problems of further developing research in this field. The Scientific Council for the Problem "Atomic and Molecular Spectroscopy" of the USSR Academy of Sciences and the Tajik SSR Academy of Sciences held it. The papers of Lenin Prize winner Doctor of Physical Mathematical Sciences S.A. Akhmanov and Lenin Prize winner Doctor of Physical Mathematical Sciences N.I. Koroteyev (both from Moscow) evoked great interest. Scientists from the Optoacoustic Laboratory of the Physical Technical Institute imeni S. Umarov of the Tajik Academy of Sciences shared recent results of the research on Raman scattering in crystals containing impurities and under external actions. [Text] [Dushanbe KOMMUNIST TADZHIKISTANA in Russian 4 Oct 86 p 2] 13206

CSO: 1814/59

METHODS OF TREE GROWING IN DESERT REGIONS

Moscow PRAVDA in Russian 25 Aug 86 p 2

[Article by A. Gavrilov, rector of the Volgograd Agricultural Institute, under the rubric "For the USSR State Prize": "The Forest Against the Desert"]

[Text] In the spring of 1984 dust storms roared over the territory of the Kalmyk ASSR, Astrakhan, Rostov, and Volgograd oblasts. In Kalmykia alone half of the winter pastures were damaged by them. And here the lands, which were protected by plantings of shrubs, remained untouched: each of the 100 hectares of such lands saved fivefold more area of pastures from being buried by sand and helped to protect on the average 25-50 sheep from plague.

Forests and shrubs have been used from time immemorial as a means of stabilizing sands. However, it is a difficult thing to grow a tree in arid near desert. Foresters did not always succeed in seeing the fruits of their labors. Back in the 1950's and 1960's not more than a tenth of the seedlings took root in sands. They perished from hot winds, dryness, diseases, and pests. In these years scientists of the All-Union Scientific Research Institute of Agro-Forest Melioration, Moscow State University, and the Ukrainian Scientific Research Institute of Forestry and Agro-Forest Melioration and specialists of enterprises of the RSFSR and Ukrainian ministries of the forestry industry and many other planning and scientific organizations were enlisted in the solution of the problem. Thus a multipurpose group headed by Academician V. Vinogradov of the All-Union Academy of Agricultural Sciences imeni V.I. Lenin was established.

Work was performed in two main directions--the study of the nature of sands and the preparation of a technology of the cultivation of plantings. The recommendations underwent checking under natural conditions, and then were used most extensively. Such advanced methods as aerospace photography and the physical modeling of forest plantings with subsequent testing in a wind tunnel were used for increasing the efficiency of research. The basic work was performed directly in the region. Thousands of kilometers of the most difficult routes were covered, a large number of wells were drilled.

It was ascertained that some sands are suitable for the cultivation of not only undemanding forest species, but also, under the protection of a forest, various grain and fodder crops, fruit trees, and vineyards and for the

development of productive pastures. That is, the possibility of the complete use of barren lands was determined. In all cases afforestation in the form of forest belts, groves, or stands should precede without fail the agricultural development of sandy areas.

The technologies of forest cultivation, which were proposed by the scientists, made it possible to protect plantings against being buried by sand and created the conditions for their supply with moisture for a lengthy period. However, new machines and implements were required for the performance of tree planting operations. Scientists in collaboration with engineers developed them. The priority nature of the innovations is confirmed by 12 inventor's certificates. The classification and mapping of the sandy areas in arid regions of the country, which were carried out by scientists, and the elaboration of a theory of their comprehensive development serve as the base for the large-scale development of forest melioration.

The developed method of cultivating forests affords extensive opportunities for the efficient use of nature and the increase of the efficiency of agricultural production. The work of the scientists is of great importance for the economic and social development of the arid regions of our country and has been deservedly nominated for the USSR State Prize.

7807
CSO: 1814/16

MONOGRAPH ON PRINCIPLES OF HYDROGEOLOGY

Moscow PRAVDA in Russian 28 Aug 86 p 2

[Article by Academician P. Melnikov under the rubric "For the USSR State Prize": "The Element of Ground Waters"]

[Text] In accordance with a decision of the United Nations the decade, which began in 1981, has been declared the International Decade of Drinking Water. It is noteworthy that precisely during this period the six-volume monograph "Osnovy gidrogeologii" [The Fundamentals of Hydrogeology], which does not have analogs in foreign literature, was published in the USSR in 1980-1984. It was prepared by a collective of authors on the initiative of the Commission for the Study of Ground Waters of Siberia and the Far East attached to the Siberian Department of the USSR Academy of Sciences.

In practice this is a hydrogeology encyclopedia. The topicality of the monograph, in addition to the urgent need for the development of the fundamental principles of hydrogeology, is determined by the need for the solution of specific problems of the national economy, which are connected with the use of water as a complex mineral--for household drinking water supply, irrigation, and medicinal and thermal power purposes. The publication is based mainly on domestic achievements in the area of the theory, methods, and practice of hydrogeological research, at the same time the experience and achievements of foreign scientists are reflected in it. "Osnovy gidrogeologii" in its content does not replace previously published works and is distinguished by the originality and comprehensive analysis of the presented problems. The volume "Obshchaya gidrogeologiya" [General Hydrogeology] has been published in English by Cambridge University.

The water of the depths of the earth is not only a mineral. This is also a natural agent which is involved in literally all geological processes. This is an element of man's environment. This is, finally, a factor which should be taken into account in case of construction or the conducting of mining operations.

On the basis of the present state and trends of development a new definition of hydrogeology as the science of the subterranean hydrosphere is given in the monograph. It studies its history, resources, composition, the laws of the spatial distribution of components, the processes occurring in it, and the

interaction with surrounding earth mantles, as well as the economic significance of the components of the subterranean hydrosphere and the influence on them of the activity of man. The authors note that in contrast to the science of ground waters, which for a long time dominated abroad, the breadth of coverage of natural phenomena and the comprehensive study of all the components of the subterranean hydrosphere--not only free ground waters, but also the waters, which are connected with rocks or are in the vapor and solid phases--characterize Soviet hydrogeology. Much attention is devoted to the origin of water in the depths of the earth, the forms of its movement, and transitions from one state to another. The latest hypotheses and ideas received elucidation on the basis of the global approach to the evolution of the earth and the consideration of the original ideas of the most prominent researchers of our century.

Great importance in the monograph is attached to the methodology and methods of hydrogeological research. In particular new methods of work (remote, geophysical, and hydrogeochemical methods and mathematical simulation) are described. On the applied level the work "Osnovy gidrogeologii" is now the only summary which in concise form states the problems of the use and protection of ground waters. In it means of solving the problem are outlined and recommendations on combating the contamination of water resources are given.

In speaking about the successes of hydrogeology in recent years, it should be taken into account that these achievements are closely connected with scientific and technical progress. For the intensive means of development of the national economy and the increase of output requires not only the increase of the proven reserves of fresh ground waters, but also the sharp increase of the economical use of water resources. The publication "Osnovy gidrogeologii" contributes both to the increase of the efficiency of hydrogeological research and to the rational use of nature.

The priority work of the large collective of Soviet hydrogeologists under the supervision of Ye. Pinneker has been worthily nominated for the USSR State Prize in science for 1986.

7807
CSO: 1814/16

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ADVANCED IN MACHINE TOOL INDUSTRY OUTLINED

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 9, Sep 86 pp 1-6

[Article: "Accelerating Scientific and Technical Progress"]

[Text] The strategic course outlined by the 27th CPSU Congress is the acceleration of our society's socioeconomic development. CPSU Central Committee General Secretary M.S. Gorbachev in the Policy Report characterized this course as follows: "What do we mean by acceleration? First of all, stepping up the pace of economic growth. But it is not just that. It's essence lies in a new quality of growth: the utmost intensification of production on the basis of scientific and technical progress, the structural reorganization of the economy, and effective forms of the management, organization, and stimulation of labor."

We should note the systematic development of the production potential of machine building and the increase of its share in the productive capital of all industry. Here a characteristic trend is the increase in this capital of the proportion of expenditures on operating machinery and equipment, that is, the active portion of the capital, which is due, first of all to the entry into machine building of greater and greater amounts of up-to-date metal working equipment, including automatic and semi-automatic equipment, NC equipment, automatic lines, industrial robots, various types of production systems, and equipment for metal-saving processes. This is an extremely important feature of the development of the economy and the scientific and technical progress of the national economy.

At the time of his visit to the Kuybyshev Jig Boring Machine Tool Plant, M.S. Gorbachev noted that among the urgent tasks of the machine tool builders are the increase of the pace of production, and the technical level and quality of the items being turned out, the assurance of smoothness of operation, and strict observance of the discipline of deliveries. During the conversations with the enterprise's workers and engineers a great deal of attention was paid to the problems of retooling and modernization in order to ensure during the 12th Five-Year Plan the output of products with a high level of technology, quality, and reliability.

The total volume of production in the machine tool building industry during 1981-1985 increased by 33.5 percent, and the increase in labor productivity amounted to 35.3 percent. The enterprises of the sector manufactured and delivered to the national economy about 800,000 metal-cutting machine tools, including approximately 50,000 NC machine tools, more than 200,000 forge-and-press machines, approximately 2,000 automatic lines for machine building and metal working, and more than 800 million rubles worth of production equipment for foundry work; more than 900 million rubles worth of equipment for wood processing and more than 5 billion rubles worth of various types of tools, were delivered.

The cited production volumes are characterized by a large scale of production. At the same time, work has been conducted on altering the production pattern by increasing the proportion of the most progressive and productive types of equipment and tools and increasing its technical level quality.

The output of NC machine tools increased during 1985, as compared with 1980, by a factor of 2.4; of them machine tools of the machining-center type increased by a factor of 2.9, while the production of industrial robots increased more than sixfold.

The updating of the items being turned out has proceeded intensively: about 3,000 types of items, of which 1,200 were designed to replace those which had been produced earlier, were developed and assimilated in series production. Large-scale production of industrial robots (PR) and flexible production modules (GPM) have been put into operation.

Among the machine tools, which were received by the national economy, are several hundred thousand automatic and semi-automatic units, special and building-block machine tools with a high productivity. Some 2,000 automatic and semi-automatic lines were created for the automotive industry, tractor and agricultural machine building, and other sectors.

The changes which are taking place today in machine tool building pertain primarily to the creation of dynamic development in the production of NC machine tools, including those like the machining center, GPM [flexible production modules], GPS [flexible production systems], and RTK [robotic complexes]. Present-day achievements in the field of automatic control systems, microprocessor equipment, electric drives, and electric automatic units have opened up broad possibilities for automation not only in large-series and mass production, but also in series and small-series production, which in machine building constitute approximately three-fourths of the total production volume.

In recent years a broad program for developing precision machine tool building has been carried out. A wide range of jig-boring, jig-grinding, precision-boring, thread-grinding, and grinding machines, with a high level of automation, is being produced.

One can make a judgment on the technical and production capabilities of heavy machine tool building by the technical characteristics of the machine tools being turned out. For example, lathes for machining parts with a diameter of

as much as 6 meters and a length of as much as 30 meters, vertical boring and turning lathes for machining parts with a diameter of as much as 22 meters, gear-hobbing machines for manufacturing gear wheels with a diameter of as much as 12.5 meters, and planers and planer-type milling machines with a table width of as much as 5 meters are being produced. The production of a number of models of heavy-duty and custom-built numerically controlled machine tools has been assimilated.

The high technical level of Soviet machine tools for machining large-scale parts ensures that they enjoy a significant demand on the world market.

The machine tool and tool building industry has large enterprises for the production of forge-and-press machinery and equipment for foundry production. In recent years there has been a substantial change in the structure of forge-and-press equipment being turned out. Within the total output of forge-and-press machinery, the proportion of equipment furnished ith the means of mechanization and automation, including automatic complexes, has increased from 12 percent in 1980 to 38.6 percent in 1985, there has also been an increase in the output of machines for metal-conserving processes--hot-stamping crank presses.

The production of fundamentally new automated complexes and numerically controlled forge-and-press machines, presses for precision stamping by the method of upsetting with torsion, machines for rotary forging, and others was assimilated.

Thus, the Voronezh Production Association for the Output of Heavy Power Presses has manufactured automated complexes based on presses for the closed die and precision hot die forging of parts of complicated configuration with a productivity of 1 million units a year. This same association has created the following: a custom-built sheet-stamping press with a force of 63 meganewtons (6,300 tons-force), designed for stamping from sheet metal the side members of truck frames up to 12 meters in length, and a press with a force of 125 meganewtons (12,500 tons-force) for stamping crankshafts and the beams of the front axles of a motor vehicle (the press is built into an automatic line).

However, during the 11th Five-Year Plan the growth rate of commodity output of forge-and-press machine building, as compared with the previous five-year plan, amount to 23.5 percent with a growth for the sector as a whole of 33.5 percent.

Significant changes have occurred in the development of the production of metal-working tools. The utilization of wear-resistant coatings, nontungsten hard alloys, synthetic diamonds, and other superhard materials has been expanded. Soviet wear-resistant coatings are applied to the cutting tools of a wide assortment on domestic units like the Bulat. The machine tool and tool building industry fully supplies the country's national economy with abrasive and diamond tools.

People abroad are very familiar with the trademark of our largest enterprises. The routing, boring, and multipurpose machine tools of the Leningrad Machine

Tool Building Production Association imeni Ya.M. Sverdlov are operating in more than 50 countries. Vertical boring and turning machines of the Krasnodarsk Machine Tool Building Plant imeni G.M. Sedin are being supplied to 40 countries. Lathes of the Ryazan Machine Tool Building Production Association are exported to more than 60 countries. Many foreign firms eagerly buy from us heavy-duty and custom-built machine tools, for example, milling machines of the Ulyanovsk Heavy-Duty and Custom-Built Machine Tool Plant, vertical boring and turning lathes of the Kolomna Heavy-Duty Machine Tool Building Plant, and boring machines of the Novosibirsk Machine Tool Building Plant imeni XVI partsyezda.

In order to solve the problem of accelerating the development of machine building in the Ministry of the Machine Tool and Tool Building Industry a drastic change in the quality and the structure of items being produced is envisaged.

In 1985 products of the highest quality within the total output of commodity production came to 48 percent. Now in production are more than 2,200 items which have been certified as belonging to the highest quality category. A number of types of progressive metal-machining equipment: the machining centers with the model numbers IR500PMF4 and IR800PMF4 of the Ivanovo Machine Tool Building Production Association imeni 50-letiya SSSR, numerically controlled lathes with the model number 1P756DF3 of the Ryazan Machine Tool Building Production Association, the hot-stamping press with the model number 8542A and the complex unit with the model number AKKB8040-02 of the Voronezh Production Association for the Output of Heavy Power Presses, and others correspond to the world level and are sold to capitalist countries.

Provision has been made in the 12th Five-Year Plan for increasing the production of progressive types of equipment, their share will increase from 43.3 percent in 1985 to 85 percent in 1990. Thus, the production of numerically controlled machine tools will increase by a factor of 2.1, the output of automatic and semi-automatic machines in 1990 will amount to 54 percent of the total output of machine tools, the production of automatic lines for metal working is planned to be increased by a factor of approximately 1.8. There will be an almost 3.3-fold increase in the output of numerically controlled forge-and-press machinery. Among numerically controlled equipment the output of machining centers will be increased sixfold, while that of flexible production modules will be increased by a factor of 2.7. The experimental assimilation of a synthetic granite (Sintegran) at the Moscow Machine Tool Building Plant of the Experimental Scientific Research Institute for Metal-Cutting Machine Tools and its industrial production at the Kaunas Tsentrolit Plant for the purpose of manufacturing particularly precise stationary base and locating parts of class S and A machine tools and measuring machines instead of parts made of cast iron is planned. This allows the preservation of a stable precision of the machine tools over a lengthy period of time.

Provisions have been made to introduce a technological process for checking machine tools and items based on the use of laser complexes, whose use with the existing checking of the precision of the positioning of high-precision and particularly high-precision machine tools will allow us to reduce the time

from 160 hours to 3 hours, that is, by more than a factor of 50. Moreover, the stability of the checking will increase due to the statistical processing of the results of the measurements, while the flexibility of the laser system allows us to perform simultaneously work on several coordinates, including control path tracing.

The introduction of technological processes for manufacturing highly precise blanks for spindles, tail spindles, and sleeves by the method of lengthwise taper rolling and upsetting on special mills will allow us to increase the utilization ratio of metal from 0.39 to 0.72.

By 1990 assembled tools with the mechanical fastening of hard-alloy plates will amount to 73.5 percent of the total output of metal-cutting tools made of hard alloys. There will be a substantial increase in the output of tools with wear-resistant coatings, the proportion of such tools made of hard alloys will amount to 47 percent.

The achievement by 1990 of the following indicators on the updating of products is envisaged: thus, the output of products being assimilated by production for the first time in the USSR will amount to 15 percent, items which have been produced for 3 years will come to 48 percent. The manufacture of articles of the highest quality category in the total output of commodity production has been set for 1990 in the amount of 66 percent.

Steps are being taken on the further development of work in the field of creating and delivering complete sets of equipment for performing all the technological operations in the machining of a number of parts. A list of machine-tool, forge-and-press, and foundry sets of technological equipment that are to be delivered during the current five-year plan, which includes 102 complete sets of equipment and 31 descriptions of parts, has been drawn up.

As compared to the previous five-year plan, during the 12th Five-Year Plan the increase by a factor of 1.5 of the volume of products exported is envisaged, here it is planned to increase by a factor of 2.5 deliveries in freely convertible currency.

For this five-year plan 14 type sizes of items, which were submitted for approval to customers, the USSR State Planning Committee, and the State Committee for Science and Technology, as well as differentiated time periods of the updating of products have been approved.

In order to ensure the output of products of a high technical level and to overcome the existing gap between domestic and foreign equipment, the Technical Level, Reliability, and Quality Sectorial Comprehensive Goal Programs have been formulated.

The Technical Level Program encompasses all kinds of technical equipment being manufactured and means of measurement and various types of tools.

The following tasks are being set for the 12th Five-Year Plan: to increase the productivity of the equipment being manufactured by a factor of 1.5-1.6;

to increase the precision of machining of equipment by a factor of 1.2; to reduce the specific metal content of the equipment being produced by 12-18 percent; to reduce the specific power-output ratio by 7-12 percent.

The program was created on the basis of study and analysis of the requirements of customers, advanced domestic and foreign know-how, as well as the trend of further development of equipment and tools. The priority list of products included in the program encompasses the most progressive groups of equipment and tools, for which long-range indicators have been specified to the year 2000. The attainment by 1990 of the long-range indicators, which conform to the world level, has been planned for the entire priority products list. The program and the long-range indicators have been reported to the enterprises and the design bureaus. They constitute the foundation for developing detailed specific measures for raising the technical level not only of items of the priority products list, but also of all products being turned out.

The Reliability Program likewise encompasses all types of equipment and tools being turned out and specifies the practical activity of enterprises and organizations on radically raising the technical level and the quality of machine building products. The program of operations contains assignments on the carrying out of the most important scientific research and design operations, the implementation of organizational and technological measures, the development of components, and the carrying out of top-priority operations on developing and introducing standard technical documentation.

The Quality Program is directed at achieving the necessary quality of products being turned out and provides for the introduction at enterprises of progressive types of machinery and mechanisms and for the improvement by means of this of the structure of the stock of equipment in this sector, the working out of standard technical documentation, the broad introduction of monitoring and test stands for the complete checking of the crucial assemblies of series-produced equipment, the supply with automated means of measurement first of all of enterprises that produce the most progressive kinds of equipment, and the introduction of the 100-percent incoming control of the quality of components. Measures on improving the organization of production and labor, on training personnel, and on improving material and technical supply are also specified.

These three programs--Quality, Technical Level, and Reliability--constitute an integrated complex of measures on achieving world levels for the items being turned out.

The Comprehensive Goal Program of the Introduction of in the Sector of Computer Equipment and Automated Systems, which encompasses all the most important directions of work, which are connected with intensifying production and increasing the technical level and quality of the products being turned out on this basis, has been formulated.

In order to raise the technical level of production of subordinate enterprises, programs of the development of assembly, forge-and-press, and foundry process stages, and the reduction of the proportion of manual labor have been formulated.

The main institutes have been made responsible for the technical level of the newly created items and for the correspondence of the long-range indicators of the products being turned out to the latest world achievements. The main organizations are obliged to make an expert appraisal of the technical documentation, to take part in the acceptance of prototypes of items, to carry out systematic monitoring of the progress of the assimilation of the new equipment, and to render technical aid to enterprises and organizations at all stages of the development and the assimilation by production of progressive types of products. The main institutes have also been charged to conduct comprehensive tests of fundamentally new types of equipment and to formulate the appropriate recommendations on eliminating the revealed shortcomings.

An important trend in scientific and technical progress in the sector will be the further increase of the level of automation of the equipment being turned out and the creation of the prerequisites for implementing a "technology with few people" in machine building. Flexible production modules and the production systems which have been built on the base should become the basis of this technology. Flexible production modules, since they have the possibilities not merely for automatic machining and the changing of tools and the part, but also the checking of the dimensions of the parts being machined and the condition of the tools and the diagnosing of the condition of all the systems, as well as a high degree of reliability, will allow us to operate the equipment in 2 to 2.5 shifts with a minimal participation of a worker. Built on the basis of modules, the flexible production systems with automated warehouses of items, tools, and machine tool attachments, which are serviced by automated transport and are controlled by a computer, are a new form of production organization in machine building.

During the 12th Five-Year Plan the development of a wide range of flexible production modules for machining and forging, die forging, and foundry operations, as well as, what is most important, the organization of their series production are planned.

Development of machine tool building will be based on a scientific foundation with the maximum use of the sectorial scientific and technical potential and with the enlistment of the scientific institutions of the USSR Academy of Sciences, the organizations of other ministries, and higher educational institutions. We are posing large tasks for sectorial science, which should head scientific and technical progress in the sector and shape the character of new equipment for the long-term future. An important role will be played by the interbranch scientific and technical complexes being formed at the present time, we are attaching great importance to the development of socialist integration and cooperation in the development of progressive metal working equipment.

Scientific, technical, and economic cooperation of the Ministry of the Machine Tool and Tool Building Industry with the related ministries of the socialist countries has already been developing successfully for a long time. The result of joint purposeful work is the steady growth of goods turnover, which during the period 1981-1985 increased by a factor of 1.7 as compared with

1976-1980. More than 70 percent of the products being exported by the ministry are delivered to the CEMA member countries and to Yugoslavia.

In accordance with the technical assignments or documentation, which were elaborated by the institutes and enterprises of the Ministry of the Machine Tool and Tool Building Industry, in the CEMA member countries the production for deliveries to the USSR of an extensive range of advanced component assemblies and items, of which during the 11th Five-Year Plan our plants received 2.3-fold more than during the previous five-year plan, has been assimilated.

Today the task of supplying: electric drives of the feed and main movement for numerically controlled metal-cutting machine tools, the production of which has been assimilated in Bulgaria, Poland, Romania, the CSSR; programmable master switches for transfer machines, which are being delivered from Bulgaria, the CSSR, the GDR, and Yugoslavia; materials handlers for automatic lines, which are produced by Bulgaria and Romania, and others in practice has already been accomplished.

Good results have been achieved in scientific and technical cooperation.

An NC automatic cylindrical grinding machine, which can be integrated with a flexible production system, was developed jointly with Bulgaria; together with the CSSR an NC multipurpose turret lathe for the complete machining of parts was developed. In cooperation with the Iskra Association (Yugoslavia) program control systems have been developed for metal-cutting machine tools; cooperation is being carried out with the GDR in the area of the development of software for control systems. Jointly with Hungary, a flexible production module for turning based on a Hungarian machine tool and a Soviet industrial robot is being developed. There are many such examples.

During the 12th Five-Year Plan the development of cooperation will receive a new content on the basis of the Comprehensive Program of Scientific and Technical Progress of the CEMA Member Countries to 2000, which was adopted at the 41st Session of CEMA, is called upon to become the foundation for the development of economic integration of the CEMA member countries for a lengthy period, and is inseparably connected with the fulfillment of the assignments envisaged by the Basic Directions of USSR Economic and Social Development for 1986-1990 and the Period to 2000.

Enterprises and organization of the ministry are directly participating in the implementation of two programs: Comprehensive Automation and the Development and Assimilation of New Materials and the Technology of Their Production and Processing.

One of the priority directions of the Comprehensive Program is the development of the work on devising flexible production systems. At the present time a General Agreement has been signed at the level of heads of state, and sectorial programs of scientific, technical, and economic cooperation have been formulated with the countries. Enterprises and organizations have begun to fulfill the assumed obligations.

During the 12th Five-Year Plan new forms of multilateral and bilateral cooperation will undergo further development. The Agreement on the Establishment of the International Scientific and Production Association Interrobot whose basic tasks are: the pursuit of a unified technical policy and the assurance of a world technical level in the field of the development of robotics for their subsequent large-scale production on the basis of specialization and cooperation, has been signed.

Jointly with Bulgaria two scientific production associations have been created for the development and production of machining centers, flexible production systems, and systems for the machining of stationary base members and parts like bodies of revolution. On the part of the USSR the Ivanovo Machine Tool Building Production Association imeni 50-letiya SSSR and the Moscow Krasnyy proletariy Machine Tool Building Production Association and on the part of Bulgaria the ZMM Association, the Beroye Combine, and enterprises, which produce electronic control systems, are joining the associations.

Joint plans of the associations on the production of equipment and components for 1986, contracts for the reciprocal deliveries of products have been signed. Scientific and technical programs for the 12th Five-Year Plan, which are aimed at increasing the technical level and improving quality of the products being manufactured, have been formulated.

More than 50 enterprises and planning organizations of the USSR and Bulgaria are involved in collaborations on the cooperative production of automatic lines. Based on this, the Ministry of the Machine Tool and Tool Building Industry manufactured approximately 340 automatic lines during 1983-1985.

Reciprocal deliveries between the USSR and Bulgaria of machine tool and tool building products, which were devised through joint development, are constantly increasing. During the 12th Five-Year Plan their volume will increase by more than a factor of 1.4 as compared to the 11th Five-Year Plan.

The Ministry of the Machine Tool and Tool Building Industry and the Bulgarian Ministry of Machine Building have signed the Sectorial Program of Economic, Scientific, and Technical Cooperation and the Specialization and Cooperation of Production to 2000 within the framework of the Long-Range Program of the Development of Cooperation Between the USSR and Bulgaria for the Period to 2000.

The Sectorial Program provides for further development of the established relations, the expansion of scientific, technical, and production cooperation, and the development of new types of highly productive automated equipment.

The outlined goals will be attained by implementing the long-term, comprehensive scientific and technical programs on the increase of the technical level, quality, and reliability of the equipment being turned out, for which the long-range indicators which exceed the world level have been made the basis. The programs likewise provide for a set of specific measures which ensure the achievement of these indicators and high quality and reliability at this sector's enterprises. Here priority attention is being

devoted to further development of the methods of modeling and comprehensive testing on the basis of the achievements of science and technology.

The accomplishment of the principal task on the change of the structure of production and the development and series assimilation of qualitatively new types of items can be achieved only on condition of a sharp rise in the technical level of production at our manufacturing enterprises. The entire increase of production volumes will be attained by means of the growth of labor productivity.

The basic directions of work in this matter are further improvement in the forms of labor organization and the retooling of operating enterprises. More than half of all the capital investments are being allocated for retooling in the 12th Five-Year Plan, moreover, they are also being concentrated at enterprises which should provide the basic increase in the output of the most progressive types of equipment. The measures outlined by the ministry should provide a more rapid pace of the updating of the stock of equipment in the sector than in previous years.

The most progressive technological processes with the utilization of highly productive automated equipment are being incorporated in the plans of retooling.

A characteristic of the retooling, modernization, and expansion at enterprises at the present stage is their large scale. Thus, for example, the introduction of capacity solely with regard to machine tools like the machine center constitutes 170 percent of the total output of these machines in 1986.

The practical effectiveness of the retooling, modernization, and expansion at the operating enterprises of the sector will depend primarily on the implementation of the plans for capital construction, both by organizations of the contracting ministries and departments and by the construction and installation subdivisions of the ministry.

The machine tool and tool building industry today is a multisectorial scientific technical complex, within which are concentrated hundreds of production associations, enterprises, and their affiliates, several dozen scientific research, design, planning and technological, and planning organizations.

Despite the fact that during the 11th Five-Year Plan machine tool builders accomplished a definite amount of work, it is necessary to further solve a number of important problems: we should improve more rapidly the structure of output by increasing the production of the most progressive groups of equipment and should increase the degree of its provision with machine-tool attachments and tools. Nor can we be satisfied with the technical level of a large number of items, we have to sharply increase the quality, precision, and reliability of the products being turned out. Work will be launched on a wider scale on supplying customers with complete sets of equipment for performing all the operations of machining parts, which are envisaged by the technological process. All this will require the substantial reorganization of all the work.

The scientific and technical potential which has been accumulated in the sector, the widespread utilization of scientific and technical achievements, and the creative contribution of labor groups at enterprises and organizations will enable us to accomplish the new long-range tasks which were specified by the 27th CPSU Congress. We have to accelerate the development and output of progressive equipment, which is needed for the retooling of machine building, increase the productivity of the new equipment, and significantly reduce its metal content and power-output ratio.

Guided by the decisions of the 27th CPSU Congress, the workers of the sector are critically analyzing the achieved results, are seeking additional reserves, and are elaborating specific measures, which will make it possible to successfully fulfill the large and complicated tasks facing the Ministry of the Machine Tool and Tool Building Industry during the current five-year plan.

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